

# **AEROSPACE MEDICINE AND BIOLOGY**

**A CONTINUING BIBLIOGRAPHY  
WITH INDEXES**

**(Supplement 307)**

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1988 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



Scientific and Technical Information Division 1988  
National Aeronautics and Space Administration  
Washington, DC

# INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 203 reports, articles and other documents announced during January 1988 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects of biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1988 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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## TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED

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ON MICROFICHE

ACCESSION NUMBER	→	<b>N88-10483*</b>	Texas Univ., Houston. Health Science Center.	←	CORPORATE SOURCE
TITLE	→	<b>PREVENTION OF DISUSE OSTEOPOROSIS: EFFECT OF SODIUM FLUORIDE DURING FIVE WEEKS OF BED REST Final Report</b>			
AUTHOR	→	VICTOR S. SCHNEIDER	Oct. 1987 64 p	←	PUBLICATION DATE
		(Contract NAS9-16688)		←	AVAILABILITY SOURCE
REPORT NUMBERS	→	(NASA-CR-172018; NAS 1.26:172018)	Avail: NTIS HC A04/MF	←	PRICE CODE
		A01	CSCL 06E		
COSATI CODE	→	<p>An attempt was made to modify factors which promote disuse osteoporosis and thereby prevent it from occurring. Since fluoride is currently used to enhance bone formation in the treatment of low turnover osteoporosis, it was hypothesized that if the fluoride ion was available over a long period of time that it would slow the demonstrated loss of calcium by inhibiting bone resorption and enhancing bone formation. This study was used to determine whether oral medication with sodium F will modify or prevent 5 weeks of bed rest induced disuse osteoporosis, to determine the longitudinal effects of 5 weeks of bed rest on PTH, CT and calcitriol, to measure muscle volume changes and metabolic activity by magnetic resonance imaging and magnetic resonance spectroscopy during prolonged bed rest, to measure changes in peak muscle strength and fatigability, and to measure bone turnover in bone biopsies. Subjects were studied during 1 week of equilibration, 4 weeks of control ambulation, 5 weeks of bed rest, and 1 week of reambulation.</p> <p style="text-align: right;">E.R.</p>			

## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

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ACCESSION NUMBER	→	<b>A88-12321*</b>	National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.	
TITLE	→	<b>CONTINUOUS MONITORING OF BLOOD VOLUME CHANGES IN HUMANS</b>		
AUTHORS	→	H. HINGHOFFER-SZALKAY and J. E. GREENLEAF (NASA, Ames Research Center, Moffett Field, CA; Graz, Universitaet, Austria)	←	AUTHOR'S AFFILIATION
JOURNAL TITLE	→	Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Sept. 1987, p. 1003-1007. Research supported by the Oesterreichische Akademie der Wissenschaften. refs (Contract NASA TASK 199-21-12-07)	←	PUBLICATION DATE
		<p>Use of on-line high-precision mass densitometry for the continuous monitoring of blood volume changes in humans was demonstrated by recording short-term blood volume alterations produced by changes in body position. The mass density of antecubital venous blood was measured continuously for 80 min per session with 0.1 g/l precision at a flow rate of 1.5 ml/min. Additional discrete plasma density and hematocrit measurements gave linear relations between all possible combinations of blood density, plasma density, and hematocrit. Transient filtration phenomena were revealed that are not amenable to discontinuous measurements.</p> <p style="text-align: right;">I.S.</p>		

# AEROSPACE MEDICINE AND BIOLOGY

*A Continuing Bibliography (Suppl. 307)*

FEBRUARY 1988

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## LIFE SCIENCES (GENERAL)

Includes genetics.

### A88-10221

**THE ROLE OF INDIVIDUAL TYPOLOGICAL FEATURES OF HIGHER NERVOUS ACTIVITY IN THE FORMATION AND THE RADIATION RESISTANCE OF CONSOLIDATED MOTOR-DEFENSIVE CONDITIONED REFLEXES IN RATS (ROL' INDIVIDUAL'NYKH TIPOLOGICHESKIKH OSOBENNSTEI VYSSHEI NERVNOI DEIATEL'NOSTI V FORMIROVANII I VYSSHEI NERVNOI DEIATEL'NOSTI V FORMIROVANII I RADIATIONNOI US-TOICHIVOSTI UPROCHNENNYKH DVIGATEL'NO-OBORONITEL'NYKH USLOVNYKH REFLEKSOV U KRYSA)**

A. S. SHTEMBERG (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) Akademiia Nauk SSSR, Izvestiia, Seriya Biologicheskaiia (ISSN 0002-3329), July-Aug. 1987, p. 547-557. In Russian. refs

The dynamics of the formation of consolidated motor-defensive conditioned reflexes in rats irradiated with gamma rays were studied together with the radiation resistance of these reflexes. In a preliminary study of the parameters of higher nervous activity in individual animals, rats were divided into two typological groups on the basis of excitability, activity, and emotion: high reactivity (group 1) and low reactivity (group 2) groups. It was found that, in the rats of the second group, the postradiation dynamics of the conditioned motor-defensive reflex activity was much better retained than in the rats of the first group in the phase of rehabilitation, but less well retained in the phase of progressive inhibition. The present conditioned reflex was better retained than the trace reflex. I.S.

### A88-10223

**EFFECT OF MICROWAVES ON THE IMPULSE ACTIVITY OF CEREBELLAR PURKINJE CELLS IN CATS [DEISTVIE MIKROVOLN NA IMPUL'SNUIU AKTIVNOST' KLETOK PURKIN'E MOZZHECHKA KOSHEK]**

O. A. KRYLOV, R. A. GRIGOR'IAN, and A. A. MAGERRAMOV (Tsentral'nyi Nauchno-Issledovatel'skii Institut Kurortologii i Fizioterapii, Moscow; AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, June 1987, p. 724-729. In Russian. refs

The cerebella of anesthetized cats were irradiated with microwaves of 460-mHz-frequency administered to the temple area of the animals (at the rates of 80, 400, and 1200 mW/sq cm), and the impulse responses of the Purkinje cells were registered extracellularly with microelectrodes placed at the V-VI vermis cerebelli section. The reactions of the Purkinje cells included a shortening of the latent reaction period, a change of the impulse activity rate, a shortening of the inhibitory pause, an increase in the frequency of first simple and then complex spikes, and finally, the appearance of bursts in the Purkinje cell impulse activity. I.S.

### A88-10224

**THE DYNAMICS OF LOCAL BLOOD FLOW IN DIFFERENT AREAS OF THE HYPOTHALAMUS DURING THE SLEEP-WAKEFULNESS CYCLE [DINAMIKA MESTNOGO KROVOTOKA V RAZLICHNYKH OBLASTIAKH GIPOTALAMUSA V TSIKLE BODRSTVOVANIE-SON]**

L. S. NIKOLAISHVILI and M. I. DEVDARIANI (AN GSSR, Institut Fiziologii, Tbilisi, Georgian SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, June 1987, p. 750-755. In Russian. refs

### A88-10225

**DIRECT EFFECT OF HYPOXIA ON THE FUNCTIONS OF SKELETAL MUSCLE VESSELS IN CATS [PRIAMO EFFEKT GIPOKSII NA FUNKTSII SOSUDOV SKELETNYKH MYSHTS U KOSHEK]**

S. A. POLENOV and G. V. CHERNIAVSKAIA (AMN SSSR, Nauchno-Issledovatel'skii Institut Eksperimental'noi Meditsiny, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, June 1987, p. 775-782. In Russian. refs

The direct effects of low-, medium-, and high-level hypoxias on various characteristics of peripheral vessels (the capacitance and resistance, the elasticity of venous walls, the capillary filtration coefficient, and the mean capillary pressure) of decentralized hind-limb muscles of cats were measured in animals breathing O<sub>2</sub>/N<sub>2</sub> mixtures that contained 18, 14, and 8 percent oxygen, respectively. The low-level hypoxia did not significantly affect the measured vessel parameters. Moderate and severe hypoxias, on the other hand, reduced the perfusion pressure (by 3.5 and 9 percent, respectively), and increased the capillary filtration coefficient (by 16 and 19 percent). However, the vascular capacity, the distensibility of veins, and the capillary hydrostatic pressure in these animals remained at the control levels. I.S.

### A88-10296

**USE OF THE ISING MODEL FOR THE DESCRIPTION OF THE ALLOSTERIC KINETICS OF POLYMERIC ENZYMES [ISPOL'ZOVANIE MODELI IZINGA DLIA OPISANIIA ALLOSTERICHESKOI KINETIKI POLIMERNYKH FERMENTOV]**

D. A. CHEREPANOV (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Prikladnoi Molekuliarnoi Biologii i Genetiki, Moscow, USSR) Biofizika (ISSN 0006-3029), vol. 32, July-Aug. 1987, p. 592-596. In Russian. refs

The kinetics of complex polymeric enzymes, such as phosphofructokinase or glutaminase, is described using Ising's (1925) model of cooperative interactions which makes it possible to account for the cooperative interaction of the protomers of a highly complex enzyme with each other. Thus, two levels of cooperative interactions could be examined. The cooperative interaction of the neighboring protomers of a polymeric enzyme were described on the basis of Ising's one-dimensional model, and the interaction of polypeptide subunits that compose each protomer were described by analogy with the model of indirect cooperation of Monod-Wyman-Changeux (1965). A detailed analysis of a one-ligand model of a polymeric enzyme is presented. I.S.

**A88-10297****TEMPERATURE DEPENDENCE OF THE RAPID NEGATIVE PHASE IN THE BACTERIORHODOPSIN CYCLE [O TEMPERATURNOM ZAVISIMOSTI BYSTROI OTRITSATEL'NOI FAZY V TSIKLE BAKTERIORODOPSINA]**

S. K. CHAMOROVSKII, A. A. KONONENKO, A. B. RUBIN, and D. S. CHERNAVSKII (Moskovskii Gosudarstvennyi Universitet; AN SSSR, Fizicheskii Institut, Moscow, USSR) *Biofizika* (ISSN 0006-3029), vol. 32, July-Aug. 1987, p. 601-605. In Russian. refs

The temperature dependence of photoelectrogenesis in the bacteriorhodopsin cycle was studied by comparing the kinetic and the amplitude parameters of the negative phase of photopotential generation in bacterial purple membranes (PMs) at 282 and 160 K. Photopotentials were measured in oriented films of PMs, using the preparation and the measurement techniques described by Maksimych and his coworkers (1984). It was shown that the negative phase of the light-induced potential remains fast (the rate of the potential drop was shorter than 300 ns at temperatures up to 113 K); the amplitude of the potential drop at the cryogenic temperatures was near that measured at room temperature, but the breakup of the negative phase at low temperatures was much slower than at room temperature. These data were analyzed in the framework of the Chernavskii-Chernavskii model (1981). The results indicate that this phase of the membrane potential generation can be related to electron movement along the retinal for the distance of 10 Å. I.S.

**A88-10298****UNCOUPLED OXIDATION IN RAT HEART MITOCHONDRIA [O NESOPRIAZHENNOM OKISLENII V MITOKHONDRIIAKH SERDTSIA KRYSY]**

R. N. AKHMEROV (AN USSR, Institut Fiziologii, Tashkent, Uzbek SSR) *Biofizika* (ISSN 0006-3029), vol. 32, July-Aug. 1987, p. 606-608. In Russian. refs

Respiration velocities, the respiratory control coefficients, and the ADP/O ratios were measured for coupled and uncoupled oxidation reactions in intact mitochondria of the rat heart prepared by the method of Deshpande et al. (1961). The mitochondria were found to possess high oxidizing efficiency with pyruvate and malate as substrates in the presence of ADP. On the other hand, the oxidation of succinate was more efficient in the absence of ADP. It is suggested that the uncoupled oxidation observed in the intact mitochondria is likely to be the result of the presence in the rat heart of a mitochondrial population with a highly permeable inner membrane. The nature and the origin of the uncoupled respiratory system in endotherms are examined, and the role of the system in heat generation is discussed. I.S.

**A88-10722****THE NEUROPHYSIOLOGICAL ASPECT IN INVESTIGATIONS OF THE SYSTEM ORGANIZATION OF CORTICAL ACTIVITY [NEIROFIZIOLOGICHESKII ASPEKT ISSLEDOVANII SISTEMNOI ORGANIZATSII DEIATEL'NOSTI GOLOVNOGO MOZGA]**

V. N. DUMENKO (AN SSSR, Institut Vyshego Nervnoi Deiatel'nosti i Neurofiziologii, Moscow, USSR) and M. N. LIVANOV *Uspekhi Fiziologicheskikh Nauk* (ISSN 0301-1798), vol. 18, July-Sept. 1987, p. 6-16. In Russian.

The concept of spatial synchronization (SS) of cortical neuronal activity (i.e., the space and time interrelation between cortical potentials and the interrelated changes in the neuronal activity in different areas of the cortex) is discussed. Consideration is given to psychological studies of the SS of cortical potentials in man and to changes in SS under psychological disorders and in the process of learning. The functional significance of the SS phenomenon is demonstrated. I.S.

**A88-10723****ELECTROENCEPHALOTOPOSCOPY AND THE FUNCTIONAL STATUS OF THE CEREBRAL CORTEX [ELEKTROENTSEFALOTOPOSKOPIIA I FUNKTSIONAL'NOE SOSTOIANIE GOLOVNOGO MOZGA]**

I. N. KNIPST and N. S. KUROVA (AN SSSR, Institut Vyshego Nervnoi Deiatel'nosti i Neurofiziologii, Moscow, USSR) *Uspekhi Fiziologicheskikh Nauk* (ISSN 0301-1798), vol. 18, July-Sept. 1987, p. 17-38. In Russian.

Studies of the functional status of the brain conducted on the basis of multichannel measurements of its spontaneous and evoked electrical activity are discussed. The methods based on the values of the electrical potentials are examined and assessed. It is emphasized that the brain system activities are reflected by the changes in the patterns of the spatial synchronization (SS) of neuronal potentials; thus, the studies of brain function should be based on the analysis of the SS patterns of neuronal potentials. I.S.

**A88-10724****EXPERIMENTAL AND THEORETICAL BASES OF THE HYPERPOLARIZATION THEORY OF INTERNAL INHIBITION [K EKSPERIMENTAL'NOMU I TEORETICHESKOMU OBOSNOVANIU GIPERPOLIARIZATSIONNOI TEORII VNUTRENNEGO TORMOZHENIIA]**

G. I. SHUL'GINA (AN SSSR, Institut Vyshego Nervnoi Deiatel'nosti i Neurofiziologii, Moscow, USSR) *Uspekhi Fiziologicheskikh Nauk* (ISSN 0301-1798), vol. 18, July-Sept. 1987, p. 80-97. In Russian.

During the development of internal inhibition in the neo cortex and in other cerebral structures, the EEG records exhibit an increase of phase-related characteristics, together with indicators of alternating activation/inhibition of impulse activity and the related slow potential oscillations. These activities are shown to be related to hyperpolarization of new-cortex neurons which takes place due to an increasing response of cortical inhibitory systems to a new stimulus, which acquires inhibitory significance in the learning process. Fluctuations (dissimilar in different brain structures) in the excitability of the neuronal populations taking place during increased inhibitory hyperpolarization are considered to have regulatory effect on the conductance of stimuli to the effectors. I.S.

**A88-10725****SIGNIFICANCE OF THE CONCEPT OF THE SPATIAL SYNCHRONIZATION OF CEREBRAL ELECTRICAL PROCESSES FOR PSYCHOPHYSIOLOGICAL INVESTIGATIONS [ZNACHENIE KONTSPTSII PROSTRANSTVENNOI SINKHRONIZATSII ELEKTRICHESKIKH PROTSESSOV GOLOVNOGO MOZGA DLIA PSIKHOFIZIOLOGICHESKIKH ISSLEDOVANII]**

N. E. SVIDERSKAIA and T. A. KOROLKOVA (AN SSSR, Institut Vyshego Nervnoi Deiatel'nosti i Neurofiziologii, Moscow, USSR) *Uspekhi Fiziologicheskikh Nauk* (ISSN 0301-1798), vol. 18, July-Sept. 1987, p. 98-136. In Russian. refs

It is shown that the analysis of the patterns of the spatial synchronization (SS) of cerebral electrical activity can be used in investigations of mental activity. Evidence is presented for the fact that the individual characteristics and the functional state of an organism can be deduced from the characteristics of the SS of the cortical potentials. The results of a topographic analysis of synchronous electrical processes are presented. I.S.

**A88-10819\*# Rice Univ., Houston, Tex.****MECHANISMS OF CELL DAMAGE IN AGITATED MICROCARRIER TISSUE CULTURE REACTORS**

ROBERT S. CHERRY and E. TERRY PAPOUTSAKIS (Rice University, Houston, TX) World Congress on Chemical Engineering, 3rd, Tokyo, Japan, Sept. 1986, Paper. 4 p. refs (Contract NAS9-17403)

Cells growing on microcarriers may be damaged by collisions of the microcarrier against another microcarrier or the reactor agitator. Bead-bead collisions are caused by small-scale turbulence, which can also cause high local shear stress on the cells. The

cells are also exposed to 10-20 Hz cyclic shear stress by bead rotation. Author

**A88-10822\*** Pennsylvania State Univ., University Park.  
**SEPARATION OF CELLS FROM THE RAT ANTERIOR PITUITARY GLAND**

W. C. HYMER and J. MICHAEL HATFIELD (Pennsylvania State University, University Park) IN: Cell separation: Methods and selected applications. Volume 3. New York, Academic Press, Inc., 1984, p. 163-194. refs  
 (Contract PHS-CA-23248; NCA2-OR-589-101; NAS9-15566)

Data concerned with analyzing the cellular organization of the rat anterior pituitary gland are examined. The preparation of the cell suspensions and the methods used to separate pituitary cell types are described. Particular emphasis is given to velocity sedimentation at unit gravity, density gradient centrifugation, affinity methods, fluorescence activated cell sorting, and density gradient and continuous-flow electrophoresis. The difficulties encountered when attempting to compare data from different pituitary cell separation studies are discussed, and results from various experiments are presented. The functional capabilities of the separated cell populations can be tested in various culture systems. I.F.

**A88-10823\*** Pennsylvania State Univ., University Park.  
**HOLLOW FIBERS - THEIR APPLICATIONS TO THE STUDY OF MAMMALIAN CELL FUNCTION**

W. C. HYMER, M. ANGELINE, J. HARKNESS (Pennsylvania State University, University Park), M. CHU (Roswell Park Memorial Institute, Buffalo, NY), R. GRINDLELAND (NASA, Ames Research Center, Moffett Field, CA) et al. IN: Regulation of target cell responsiveness. Volume 1. New York, Plenum Publishing Corp., 1984, p. 407-459; Discussion, p. 459-461. Research supported by the Lyndhurst Foundation and Pennsylvania State University. refs  
 (Contract NIH-CA-23248; NCA2-OR-589-101; NAS9-15566)

The use of hollow fiber technology in cell culture and transplantation is examined. The morphologies of encapsulated pituitary cells before and after implantation into the rat are defined. Implantation experiments using hollow fibers to study mammalian cell functions are described. Consideration is given to examining somatotroph, prolactin, prostrate, fibroblast, and retinal cell functions. These experiments demonstrate that hollow fiber technology is applicable for studying mammalian cell functions. I.F.

**A88-10887** Indiana Univ., Bloomington.  
**ISOTOPIC COMPOSITIONS AND PROBABLE ORIGINS OF ORGANIC MOLECULES IN THE EOCENE MESSEL SHALE**

J. M. HAYES, RAY TAKIGIKU (Indiana University, Bloomington), RUBEN OCAMPO, ENRY J. CALLOT, and PIERRE ALBRECHT (Strasbourg I, Université, France) Nature (ISSN 0028-0836), vol. 329, Sept. 3, 1987, p. 48-51. NASA-NSF-supported research. refs

It is shown here that the carbon isotopic compositions of biomarkers from the Eocene Messel shale, accumulated 47 + or - 2 million years ago in anaerobic waters at the bottom of a lake, allow identification of specific sources for some materials and reconstruction of carbon flows within the lake and its sediments. The C-13 content of organic matter synthesized by lacustrine primary producers can be estimated from the observed C-13 content of the geoporphyrins derived from their chlorophylls. Total organic material in the shale is depleted in C-13 by six parts per thousand relative to that input. This difference cannot be explained by selective loss of components enriched in C-13, nor, as shown by isotopic compositions of other biomarkers, by inputs from land plants surrounding the lake or from methanogenic bacteria. C.D.

**A88-10888\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**GRAVITATIONAL HAEMODYNAMICS AND OEDEMA PREVENTION IN THE GIRAFFE**

ALAN R. HARGENS (NASA, Ames Research Center, Moffett Field; USVA, Medical Center; California, University, San Diego), RONALD W. MILLARD (Cincinnati, University, OH), KNUT PETTERSSON (AB Haasle, Molndal, Sweden), and KJELL JOHANSEN Nature (ISSN 0028-0836), vol. 329, Sept. 3, 1987, p. 59, 60. Research supported by the National Geographic Society, NIH, and NSF. refs

The question of how giraffes avoid pooling of blood and tissue fluid (edema) in dependent tissues of their extremities is addressed. As monitored by radiotelemetry, the blood and tissue fluid pressures that govern transcapillary exchange vary greatly with exercise. These pressures, combined with a tight skin layer, move fluid upward against gravity. The skin thus functions like a natural antigravity suit. Other mechanisms that prevent edema include precapillary vasoconstriction and low permeability of capillaries to plasma proteins. C.D.

**A88-10889**  
**A BACTERIAL CALCIUM-BINDING PROTEIN HOMOLOGOUS TO CALMODULIN**

DAVID G. SWAN, RICHARD S. HALE, NAMRITA DHILLON, and PETER F. LEADLAY (Cambridge University, England) Nature (ISSN 0028-0836), vol. 329, Sept. 3, 1987, p. 84, 85. Research supported by the Wellcome Trust and Medical Research Council. refs

The complete amino-acid sequence of a calcium-binding protein from the Gram-positive bacterium *Streptomyces erythraeus* has been determined by cloning and sequencing the corresponding gene. It contains four EF-hand motifs bearing remarkable sequence similarity to the calcium-binding sites in calmodulin. This implies that the EF-hand superfamily may have evolved from ancient proteins present in prokaryotes. C.D.

**A88-10943\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**REDUCTION OF SPERMATOGONIA AND TESTOSTERONE IN RAT TESTES FLOWN ON SPACE LAB-3**

DELBERT E. PHILPOTT, J. STEVENSON, S. BLACK (NASA, Ames Research Center, Moffett Field, CA), W. SAPP, C. WILLIAMS (Tuskegee Institute, AL) et al. IN: Electron Microscopy Society of America, Annual Meeting, 44th, Albuquerque, NM, Aug. 10-15, 1986, Proceedings. San Francisco, CA, San Francisco Press, Inc., 1986, p. 248, 249. refs

The effects of space flight on rat testes were investigated. The weight, spermatogonial cell count, and testosterone levels in six rats flown on Space Lab-3 were measured. It is observed that compared to ground control rats the average weight loss was 7.1 percent and the spermatogonial cell count decreased by 7.5 percent. The data reveal that the testosterone level for large control rats was 9.13 ng/ml and 0.31 ng/ml for flight rats; and 2.54 ng/ml and 0.233 ng/ml for smaller control and flight rats, respectively. It is noted that spermatogenesis and testosterone production are reduced during spaceflight. I.F.

**A88-10959\*** Louisville Univ., Ky.

**INTERFERON EFFECTS ON PROTOZOAN INFECTIONS**

G. SONNENFELD (Louisville, University, KY), J. WIRTH (Michigan State University, East Lansing), F. KIERSZENBAUM, A. L. W. DEGEER, and J. M. MANSFIELD (Wisconsin, University, Madison) IN: Interferon System. New York, Raven Press (Serono Symposia. Volume 24), 1985, p. 195-199. refs  
 (Contract NCC2-213; NIH-AI-18848; NIH-AI-17041; NIH-AI-07203; NIH-AI-22441)

The effects of interferon (IFN) on mice infected with two different parasitic protozoans, *Trypanosoma cruzi* and *Trypanosoma brucei rhodesiense*, are investigated experimentally. The preparation of the cell cultures, IFN and assays, antibody, and the experimental procedures are described. It is observed that in cells treated with IFN-gamma there is an increased association of *T. cruzi* with murine

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macrophages and an increase in the killing of *T. cruzi* by IFN-gamma-treated murine macrophages. For spleen cells infected with *T.b. rhodesiense* in vitro, it is detected that live trypanosomes cannot induce IFN in cells from normal mice, but can in cells from immunized mice; and that trypanosome-lysates induce IFN in vitro in cells from normal mice. The data suggest that there is a two-step mechanism for mice against *T. cruzi* and *T.b. rhodesiense*. I.F.

### A88-10972\*

#### SEPARATION OF CELLS FROM THE RAT ANTERIOR PITUITARY GLAND

WESLEY C. HYMER and J. MICHAEL HATFIELD IN: *Methods in enzymology*. Volume 103. New York, Academic Press, Inc., 1983, p. 257-287. refs  
(Contract NIH-CA-23248; NCA2-OR-589-101; NAS9-15566)

Various techniques for separating the hormone-producing cell types from the rat anterior pituitary gland are examined. The purity, viability, and responsiveness of the separated cells depend on the physiological state of the donor, the tissue dissociation procedures, the staining technique used for identification of cell type, and the cell separation technique. The chamber-gradient setup and operation, the characteristics of the gradient materials, and the separated cell analysis of velocity sedimentation techniques (in particular Staput and Celscp) are described. Consideration is given to the various types of materials used in density gradient centrifugation and the operation of a gradient generating device. The use of electrophoresis to separate rat pituitary cells is discussed. I.F.

### A88-12319

#### HYPOXIA-INDUCED ALTERATIONS OF NOREPINEPHRINE VASCULAR REACTIVITY IN ISOLATED PERFUSED CAT LUNG

M. CUTAIA and P. FRIEDRICH (USVA, Medical Center, Northport, NY) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Sept. 1987, p. 982-987. refs

Responses of isolated perfused cat lung to norepinephrine (NE) were measured under four conditions of NE infusion: (1) during normoxia; (2) after vascular resistance (Rpv) was increased by serotonin (S); (3) after Rpv was increased by hypoxia (H), at 27-56 Torr of oxygen pressure; and (4) after lobar pressure was raised by an increase in flow. It was found that the NE response was unchanged during S (which raised Rpv to a greater extent than did the average hypoxic stimulus), and that the response to NE did not correlate with the increase in Rpv during acute H, S infusion, or the increase in pressure after an increase in flow. In contrast, a correlation was found between P(O<sub>2</sub>) and the NE response during H, which was disrupted by beta-blockade. The results suggest that the alteration of NE vascular activity during acute H was independent of the prevailing level of vascular tone. I.S.

### A88-12322

#### HYPOXIA-INDUCED INHIBITION OF CONVERTING ENZYME ACTIVITY - ROLE IN VASCULAR REGULATION

HONGKUI JIN, SUZANNE CPARIL, HYUNG SOO ANN, RENHUI YANG, and ROBERT M. JACKSON (Alabama, University, Birmingham) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Sept. 1987, p. 1012-1018. Research supported by the American Lung Association and USVA. refs  
(Contract NIH-HL-22544; NIH-HL-25451)

The functional significance of hypoxia-induced inhibition of angiotensin-converting enzyme activity in vascular control was assessed by determining pressor responses in pulmonary and systemic arteries of hypoxia-exposed (10 percent O<sub>2</sub> for 14 and 28 days) and air control rats to intravenous administration of graded doses of angiotensin I (Ang I) and Ang II. Exposure to hypoxia led to progressive pulmonary hypertension but did not alter systemic arterial pressure. Systemic pressor responses to Ang I and Ang II were significantly less in the hypoxic rats than in the controls rats, and the changes were reversible. Pulmonary pressor responses to Ang I were significantly less at 14 days of hypoxia, than in control rats, whereas responses to Ang II were greater at 28 days of hypoxia. It is suggested that the altered systemic and

pulmonary pressor responsiveness to Ang I and Ang II in hypoxic rats is related to mechanisms specific to the renin-angiotensin system. I.S.

### A88-12426

#### INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCES, COMMISSION ON GRAVITATIONAL PHYSIOLOGY, ANNUAL MEETING, 8TH, TOKYO, JAPAN, NOV. 4-8, 1986, PROCEEDINGS

ORR E. REYNOLDS, ED. *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, 161 p. For individual items see A88-12427 to A88-12473.

The topics discussed in this volume include current concepts of gravitational physiology; recent space flight results in gravitational physiology; space flight results and topics in terrestrial environment; body position and the simulation of gravity; mammalian gravireception and brain function; the models of weightlessness, fluid shifts and electrolytes; human and animal models of weightlessness; hypogravity and gravireception; and gravitational physiology. Papers are presented on the physiological limitations of human tolerance to Gz acceleration, magnetic effect on cardiopulmonary function in man, cardiovascular effects of head-up tilting on muscle sympathetic activities in man, and sensory interaction in weightlessness. Attention is also given to the mechanism of plasma volume increase during head-out water immersion in dogs, metabolic adaptation to hypokinesia in humans, controlled water immersion as a model of weightlessness, and cardiovascular responses to central hypovolemia in man. I.S.

A88-12428\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

#### SPACELAB LIFE SCIENCES 1 AND 2 SCIENTIFIC RESEARCH OBJECTIVES

CAROLYN S. LEACH and HOWARD J. SCHNEIDER (NASA, Johnson Space Center, Houston, TX) (*International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986*) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-6 to S-9. refs

The pressurized Spacelab module was designed and built to allow investigators to conduct research in space in an environment approximating that of a ground-based laboratory. It is configured to allow multiple investigations employing both human and nonhuman subjects. This flexibility is exemplified by the SLS-1, SLS-2, and SLS-3 experiment complement. A total of 21 experiments are scheduled for these missions; the areas to be investigated are renal/endocrine function, cardiovascular/cardio-pulmonary function, hematology, immunology, metabolic activity of muscle, Ca metabolism, the vestibular system, and general biology. A plan for integration of measurements will allow each investigator to use data from other experiments. The experiments make up a scientifically balanced payload that addresses fundamental biomedical problems associated with space flight and provides the first opportunity to study the acute effects of weightlessness in a comprehensive, interrelated fashion. Author

### A88-12431#

#### GRAVITATIONAL CARDIOVASCULAR ADAPTATION IN THE GIRAFFE

ALAN R. HARGENS (California, University; USVA, Medical Center, San Diego) (*International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986*) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-15 to S-18. Research supported by the National Geographic Society. refs  
(Contract NIH-HL-32703; NSF DCB-84-09253)

The results of the hemodynamics and fluid balance studies in the giraffe are reported. In eight 3-4 m giraffes, arterial and venous blood pressures were determined in terms of 'Starling pressures' (Starling, 1986) along with interstitial fluid pressure, colloid osmotic pressure, and jugular vein pressures; these measurements were correlated with venous valve spacing studies in dissected veins



and local blood flows (by Xe-133 washout procedure). A radiotelemetry system, mounted at the base of each giraffe's neck allowed continuous monitoring of blood and interstitial fluid pressures. Two giraffes were killed, and multiple tissue samples were harvested for histologic examination. The results detected the existence of the following edema-preventing mechanisms: (1) variable and sometimes negative Starling pressures, (2) protein-impermeable capillary membranes, (3) arterial wall hypertrophy and vasoconstriction, (4) a prominent lymphatic system, and (5) skin and facial 'g-suit' combined with one-way valves in the veins and lymphatics. I.S.

**A88-12432#**  
**BIODYNAMIC RESPONSE OF SUBHUMAN PRIMATES TO VIBRATION**

ARNOLD R. SLONIM (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-19 to S-22. refs

A program was initiated to develop a method to directly measure transmissibility up the spinal column and determine the impedance of subhuman primates to vertical sinusoidal vibration. Accelerometers were implanted on the spinous process at the upper and lower region of the spine of Rhesus monkeys and later baboons. This report presents the results obtained (1) on the impedance and transmissibility characteristics of both species of primates; (2) on the application of a recently developed model to the data to obtain a better approximation of the biodynamic response; and (3), to a small extent, on an effort toward interspecies scaling to humans. Author

**A88-12435#**  
**PHYSIOLOGICAL INVESTIGATIONS OF PRIMATES ONBOARD BIOSATELLITES COSMOS-1514 AND COSMOS-1667**

O. G. GAZENKO and E. A. ILL'IN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-31 to S-35. refs

The development of the space adaptation syndrome was studied in four rhesus monkeys flown aboard the Cosmos-1514 (5-day flight) and Cosmos-1667 (7-day flight) in 1983 and 1985, respectively. It was found that at an early period of adaptation, the excitation of vestibular neurons connected with the semicircular canals and the otoliths increases. No significant variation of the blood flow velocity in the common carotid artery was revealed. It was concluded that the cause of unpleasant sensations reported by cosmonauts in the early stages of flight, such as head heaviness and blood rush to the head, is caused not by an increased arterial flow to the upper body but by some other mechanism or factor. It is suggested that the outflow of the venous blood and the cerebrospinal fluid might become hampered. By the end of 5-7 days in weightlessness, most parameters under study tended to return to normal. I.S.

**A88-12438#**  
**EFFECTS OF 7-DAY SPACE FLIGHT ON WEIGHT-BEARING AND NON-WEIGHT-BEARING BONES IN RATS (COSMOS 1667)**

L. VICO, D. CHAPPARD, A. V. BAKULIN, V. E. NOVIKOV, and C. ALEXANDRE (Saint-Etienne, Universite, France) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-45, S-46. refs

The paper discusses the results of histomorphometric studies of space-flight-induced bone changes in proximal metaphysis of the tibia and the femur (weight-bearing bones) and in the thoracic and lumbar vertebral bodies (non-weight-bearing bones) of 105-day-old rats flown aboard Bioscosmos 1667 for 7 days. Neither bone loss nor changes in bone parameters were observed in the

thoracic and lumbar vertebrae. On the other hand, in the proximal tibial metaphysis, the space flight caused significant decline in the trabecular bone volume; trabeculae were decreased in number and thickness, leading to an alteration of bone mechanical properties. Furthermore, marked differences were observed between areas with and without muscular insertions, emphasizing the important role of mechanical factors in the preservation of trabecular bone mass. I.S.

**A88-12441#**  
**A UNIQUE RELATIONSHIP BETWEEN ECONOMOS' THEORY ON THE LARGEST LAND MAMMAL AND OUR DYNAMIC THEORY OF GROWTH, MATURATION AND AGEING**

SHINOBU TATSUNAMI, NAGASUMI YAGO (Saint Marianna University, Kawasaki, Japan), and NOBUO FUKUDA (National Institute of Radiological Sciences, Chiba, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-51, S-52. refs

A power law of the effect of gravity on land mammals has been presented by Economos (1981). This law, using only one variable (i.e., the body mass of adult animals), clearly demonstrates the relationship between gravitational tolerance and body mass and estimates the most probable body weight of the largest land mammal as about 20,000 kg. This law is combined with a novel theoretical equation for body mass derived on the basis of modern molecular biology, and it is found by computer simulation that human gravitational tolerance seems to have remained almost unchanged in the past and also may not change significantly in the near future. Author

**A88-12442#**  
**STUDY OF THE INITIAL PERIOD OF ADAPTATION TO MICROGRAVITY IN THE RAT EXPERIMENT ON-BOARD COSMOS-1667**

O. G. GAZENKO, E. A. SAVINA, E. A. IL'IN, L. V. SEROVA, A. S. KAPLANSKII (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-53 to S-55. refs

Changes in the musculoskeletal, digestive, endocrine, and CNS systems of rats flown for 7 days aboard Cosmos-1667 are described. The experiments have demonstrated that a 7-day space flight is sufficient in terms of time for a number of structural, metabolic, and functional changes to emerge, due to the underloading of certain physiological systems. Most changes that develop in the course of adaptation to microgravity increase with flight time, while some variations originate at an initial stage of adaptation and remain unchanged during long-term flights. The characteristic feature of the initial adaptation stage is the absence of significant changes in blood biochemistries in the presence of structural and metabolic shifts in organs and tissues. I.S.

**A88-12444#**  
**CHANGES OF ARTERIAL AND VENOUS BLOOD FLOW DURING ORTHOSTASIS AND THE EFFECT OF ATROPINE**

W. K. PARK and E. U. CHAE (Keimyung University, Taegu, Republic of Korea) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-58, S-59. refs

This study was attempted to clarify the effect of atropine on the tolerance of the cardiovascular system to upright and head-down tilt, and to investigate the change of blood flow through head and lower leg in both tilts before and after atropine. Anesthetized dogs were tilted from supine to +77 deg upright and then to -90 deg head-down position, and the same course was taken 20 min after IV administration of 0.5 mg atropine. In upright tilt, the blood flow in both the artery and the vein through head and lower leg were decreased. Atropine attenuated the

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decrement of the blood flow in the carotid artery, but not in the vessels of the lower leg. Author

### **A88-12452# ORGANIZATION OF MACULO-OCULAR PATHWAYS VIA Y-GROUP NUCLEUS AND ITS RELEVANCE TO CEREBELLAR FLOCCULUS IN CATS**

YU SATO and TADASHI KAWASAKI (Toyama Medical and Pharmaceutical University, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-77 to S-80. refs

The topographical localization of floccular Purkinje cells projecting to the y-group nucleus in cats is studied using the retrograde axonal transport of horseradish peroxidase method. The efferent projections of target neurons of floccular caudal-zonal inhibition are investigated. The functional differences between dorsal-y-group and ventral-y-group nuclei are investigated. It is observed that the dorsal-y-group nucleus receives floccular caudal-zone inhibition and transmits otolith input to the contralateral caudal half of the oculomotor nucleus innervating superior rectus and inferior oblique muscles through the crossing ventral tegmental tract, and the ventral-y-group nucleus is free from floccular inhibition and transmits gravity inputs from the saccule to the other structures of the brain. I.F.

### **A88-12453# CHARACTERISTICS OF VESTIBULAR REACTIONS TO CANAL AND OTOLITH STIMULATION AT AN EARLY STAGE OF EXPOSURE TO MICROGRAVITY**

M. G. SIROTA, B. M. BABAEV, I. B. BELOOZEROVA, A. N. NYROVA, S. B. IAKUSHIN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-82 to S-84.

The otolith organs and semicircular canals of the vestibular apparatus of monkeys were excited in space during the Cosmos 1667 experiment. The semicircular canals were examined using the rapid gaze fixation reaction model and the otolith organs using the lift reaction model. The velocities and amplitudes of the horizontal eye and head movements, and the activity of the medial vestibular nuclei neurons were analyzed. It is observed that task fulfillment increases in the first days of flight; however, by days 5 and 7 hypersensitivity decreases gradually and returns to preflight values. The data reveal that the exposure of monkeys to

**A88-12454\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**IMPLICATIONS OF OTOCONIAL CHANGES IN MICROGRAVITY**  
MURIEL D. ROSS (NASA, Ames Research Center, Moffett Field, CA) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-90 to S-93. refs  
(Contract NAG2-325; NAS2-10535)

Otoconia of maculas of Sprague-Dawley rats (Taconic Farms) flown aboard Spacelab-3 showed no signs of demineralization. Other findings were accumulations of miniature otoconia at the lateral border of utricular patches and a smoothing of surfaces of saccular otoconia. These features were not observed in age- and weight-matched ground controls. Subsequent study showed otoconial asymmetry to be normal in this strain. Further research in space, taking this into account, is clearly required. Findings of ground-based studies would suggest that neural structures of maculas are adaptable to microgravity but might show changes over time. Moreover, maculas have the potential for integration of the sort ascribed to brain and retina, although on a less complex

scale. They may act as comparators, and asymmetry may be an important property. Coordinated studies in space and on the ground could lead to new understanding of how maculas function and adapt to new acceleratory environments; and to insights about the functioning of neural tissue in general. Author

### **A88-12455\*# Louisville Univ., Ky. PHYSIOLOGICAL RESPONSES DURING WHOLE BODY SUSPENSION OF ADULT RATS**

J. M. STEFFEN, R. D. FELL, and X. J. MUSACCHIA (Louisville, University, KY) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-94, S-95. refs  
(Contract NAG2-386)

The objective of this study was to characterize responses of adult rats to one and two weeks of whole body suspension. Body weights and food and water intakes were initially reduced during suspension, but, while intake of food and water returned to presuspension levels, body weight remained depressed. Diuresis was evident, but only during week two. Hindlimb muscle responses were differential, with the soleus exhibiting the greatest atrophy and the EDL a relative hypertrophy. These findings suggest that adult rats respond qualitatively in a manner similar to juveniles during suspension. Author

### **A88-12456\*# Arizona Univ., Tucson. INFLUENCE OF SIMULATED WEIGHTLESSNESS ON MAXIMAL OXYGEN UPTAKE OF UNTRAINED RATS**

J. MICHAEL OVERTON and CHARLES M. TIPTON (Arizona, University, Tucson) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-96, S-97. refs  
(Contract NIH-HL-33782-02; NAG2-392)

The purpose of this study was to determine the effect of hindlimb suspension on maximal oxygen uptake of rodents. Male Sprague-Dawley rats were assigned to head-down (HD) suspension, horizontal (HOZ) suspension, or cage (C) control for 6-9 days. Rats were tested for maximal oxygen uptake before and after surgical instrumentation (Doppler flow probes, carotid and jugular cannulae), and after suspension. Body weight was significantly decreased after suspension in both HD and HOZ groups, but was significantly increased in the C group. Absolute maximal O<sub>2</sub> uptake (ml/min) was not different in the C group. However, because of their increased weight, relative maximal O<sub>2</sub> uptake (ml/min per kg) was significantly reduced. In contrast, both relative and absolute maximal O<sub>2</sub> uptake were significantly lower, following suspension, for the HD and HOZ groups. These preliminary results support the use of hindlimb suspension as an effective model to study the mechanism(s) of cardiovascular deconditioning. Author

### **A88-12457# MECHANISM OF THE INCREASE IN PLASMA VOLUME DURING HEAD-OUT WATER IMMERSION (WI) IN DOGS**

KENJU MIKI (University of Occupational and Environmental Health, Kitakyushu, Japan), SUK KI HONG, and JOHN A. KRASNEY (New York, State University, Buffalo) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-100, S-101. refs

The mechanism underlying the alteration of transcapillary fluid movement during water immersion (WI) were investigated. Systemic arterial (Pa), central venous (Pv), plasma oncotic, interstitial fluid hydrostatic (pif) pressures were measured. Mean capillary pressure, which was calculated from Pa, Pv, and an estimated pre-to-postcapillary resistance ratio of 5-12, increased by 27 mmHg, while Pif increased by 27 mmHg at lower forelimb. A greater increase in Pif than mean capillary pressure during WI would create a negative hydrostatic pressure gradient across the capillary wall. The oncotic pressure gradient across the capillary wall was estimated to be less than 1.2 mmHg during WI. Thus, it is probable

that the negative hydrostatic pressure gradient for fluid movement across the capillary wall plays a major role in the increase in plasma volume which occurs during WI. Author

**A88-12458\*#** Louisville Univ., Ky.

**PHYSIOLOGICAL COMPARISON OF RAT MUSCLE IN BODY SUSPENSION AND WEIGHTLESSNESS**

X. J. MUSACCHIA, J. M. STEFFEN, R. D. FELL, and J. DOMBROVSKI (Louisville, University, KY) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-102 to S-105. refs

(Contract NAG2-386)

Hind limb unloading is achieved with whole body suspension (WBS) and with tail suspension (TS). Comparable levels of muscle mass loss and decreases in protein levels result during one to three weeks of exposure to microgravity (microG), WBS, and TS. Losses are most apparent in soleus (S), intermediate in gastrocnemius (G) and least in extensor digitorum longus (EDL). Comparison of S and EDL type I and II fiber changes (numbers and area) after seven days of microG flight and WBS showed, in S, an increase in Type I and Type II fiber density and a decrease in area. Except for a decrease in Type I fiber density in EDL, all other parameters remained comparable. The general conclusions were that the S under microG and WBS responds in a similar manner. The EDL, for the most part, shows little change under both conditions. Author

**A88-12459#**

**NEUROPHYSIOLOGICAL RESPONSES IN SUSPENDED ANIMAL MODELS**

YUTAKA OOMURA and TOSHIHIKO KATAFUCHI (Kyushu University, Fukuoka, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-106 to S-108. refs

The effects of a hypogravic condition induced by horizontal and head-down suspensions on single neuron activity in the lateral hypothalamic area (LHA) and paraventricular nucleus (PVN) of rats are studied. It is observed that horizontal suspension causes a change in the discharge frequency of 21 of 44 LHA neurons; seven of the 21 neurons increase activity immediately after raising the rat from the ground level (type I), three decrease activity immediately (type II), and 11 gradually decrease activity (type III). In the 10 neurons tested using the head-down suspension, three were of type I and seven of type III. It is detected that the activity of eight of 34 PVN neurons change due to horizontal suspension: six display a gradual decrease and two a gradual increase in activity; and eleven neurons exhibited gradual decreases in activity during head-down tilting. Signals that may induce changes in the neuron activity and the role of the hypothalamus in the regulation of the automatic nervous and endocrine systems are examined. I.F.

**A88-12460#**

**EFFECTS OF GRAVITY ON RHYTHMIC ACTIVITIES IN THE PHRENIC AND SYMPATHETIC NERVE DISCHARGES**

TAKEHIKO HUKUHARA, NOOFUMI KIMURA, KAZUO TAKANO, and FUSAO KATO (Jikei University, Tokyo, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-109 to S-112. refs

Effects of passive postural changes on the cardiac-related sympathetic nerve activity and high-frequency oscillation in the phrenic nerve discharge were quantitatively analyzed by spectral analyses. Experiments were performed on vagotomized rabbits with intact sinus nerves, anesthetized with ether, paralyzed and artificially ventilated. In the power spectrum of renal sympathetic nerve discharge, cardiac-related component was decreased by head-up tilting (30 deg) and was increased by head-down tilting (30 deg). Coherence between sympathetic nerve discharge and

arterial pulse at the frequency of cardiac rhythm was decreased by head-up tilting and was increased by head-down tilting. In the power spectrum for phrenic nerve discharge, the peak-area corresponding to the high frequency oscillation, which was estimated by nonlinear least-squares method, was increased by both the head-up and head-down tiltings. Author

**A88-12461\*#** Tennessee Univ., Knoxville.

**COMPARATIVE ASPECTS OF HEMATOLOGICAL RESPONSES IN ANIMAL AND HUMAN MODELS IN SIMULATIONS OF WEIGHTLESSNESS AND SPACE FLIGHT**

R. D. LANGE, J. B. JONES (Tennessee, University, Knoxville), and P. C. JOHNSON, JR. (NASA, Johnson Space Center, Houston, TX) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-113 to S-116. refs

This paper reviews some human and animal responses to space flight as well as in control models in simulations of weightlessness. Astronauts after space flight have been found to have a decreased red blood cell mass and plasma volume. The reason for these changes is unknown but appears to be caused primarily by a decrease in the need of red blood cells in the weightless condition. Similar though more moderate changes have been found in human subjects subjected to prolonged bed rest or water immersion. What happens to the red cell mass of laboratory rats flown in microgravity is not known but rats have shown an increase in the rate of random red cell loss in flight suggesting a probable decrease. Rat models subjected to either head-down suspension or restraint alone have shown a decrease in red blood cell masses and a decrease in their plasma volume. Author

**A88-12462#**

**LOCAL FLUID SHIFTS IN HUMANS AND RATS - COMPARISON OF SIMULATION MODELS WITH ACTUAL WEIGHTLESSNESS**

CHARLES M. TIPTON, J. MICHAEL OVERTON, MICHAEL J. JOYNER, and ALAN R. HARGENS (Arizona, University, Tucson; California, University, San Diego) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-117 to S-120. refs

Animal and human models for simulated weightlessness are described, and the effects of head-down suspension on fluid shifts in humans and rats are evaluated. It is determined that the -5 deg head-down tilt should be used for human studies and a -30 deg head-down tilt for rats. It is noted that additional data are necessary to understand the time course of fluid shifts. I.F.

**A88-12465#**

**DIRECTIONAL DIFFERENCE IN EFFECTS OF LONG-TERM HYPER-GRAVITY UPON THE CARDIAC SYSTEM OF THE HAMSTERS**

HIROTAKE SATAKE, KENICHI MATSUNAMI (Gifu University, Japan), YOSHIO MIZUNO (Daido Institute of Technology, Nagoya, Japan), and SATORU WATANABE (Nagoya University, Nagoya) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-129, S-130.

The cardiac responses of 56 anesthetized Syrian golden hamsters under hypergravity for over 10 minutes are studied. The hamsters were divided into three groups and exposed to various hypergravity conditions and centrifugal acceleration of 2, 4, 6, 8, and 10 G. Group one was exposed to hypergravity from the back to the abdomen (-Gx); in group two the direction of hypergravity was from the foot to the head (-Gz); and in group three the hypergravity was in the head to foot direction (+Gz). It is observed that the heart rate, stroke volume, and cardiac output all decreased during exposure to all three directions, and the hamsters had the highest tolerance to -Gx followed by -Gz and +Gz. I.F.

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**A88-12466#**

### **CHRONIC ACCELERATION AND ORGAN SIZE IN DOMESTIC FOWL**

A. H. SMITH (California, University, Davis) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-131, S-132. refs

The masses of some visceral organs in three groups of accelerated male fowls are estimated. It is observed that there is no statistically significant covariance of relative organ size with the gravitational field for the heart, lungs, or spleen; the relative kidney and liver sizes increase and the relative gastrointestinal tract size decreases with increasing gravitational field strength. The kidney and liver determine the metabolic rate, their size is proportional to the metabolic rate, and the metabolic rate increases with increasing acceleration field. Bone mass and the bone/muscle ratio in two of the groups are evaluated. It is detected that bone mass and the bone/muscle ratio increase and muscle mass decreases proportionally to the increasing acceleration field. I.F.

**A88-12467#**

### **CHANGES OF CARDIAC SYSTEMS OF DECEREBELLATED HAMSTERS IN HYPERGRAVITY CONDITIONS**

S. UEKI, T. KAWASHIMA, H. SATAKE, M. NAKASHIMA, and K. MATSUNAMI (Gifu University, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-133, S-134.

Cardiovascular regulation in response to hypergravity conditions is investigated using 15 control and 13 decerebellated hamsters. The hamsters were tested in a centrifugal accelerator with magnitudes of 2, 4, and 6 G and hypergravity in the tail to head direction. EKG and impedance plethysmograms were recorded, and heart rate (HR), stroke volume (SV), cardiac output (CO), and P-R and R-R intervals are analyzed. The data reveal that: (1) in the control group the HR decreased after 4 and 6 G exposure and in the decerebellated group the HR increased slightly at 2 G and decreased at 4 and 6 G; (2) in the control group the SV showed a slight decrease during exposure to 2 and 4 G and in the decerebellated group the SV decreased; (3) the CO for both groups was similar to that of the SV; and (4) in both groups the first degree of atrioventricular block was observed during exposure to 4 and 6 G. I.F.

**A88-12468#**

### **CARDIOPULMONARY RESPONSE OF RATS TO CENTRIFUGAL ACCELERATIONS**

MASAMICHI SUDOH, KUMIKO SHIODA, MIHARU KOHNO, SATIO IKAWA, KENJI KAWAKAMI (Jikei University, Tokyo, Japan) et al. (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-135, S-136.

The cardiopulmonary responses of female rats to centrifugal accelerations in the 3-6 G range and in the back to abdomen (-Gx), head to tail (+Gz), and tail to head (-Gz) directions are investigated. Cardiopulmonary responses are measured in terms of heart rate, blood pressure, and respiration rate. The data reveal that the heart rate does not change during -Gx and +Gz and it decreases during -Gz; the mean arterial pressure decreases during all three loads; transthoracic impedance decreases during the -Gx and -Gz load and increases during +Gz; and the respiration rate increases during the -Gx load and is relatively stable during +Gz and -Gz. I.F.

**A88-12469#**

### **THE RESPONSE OF SKELETAL MUSCLE MASS TO CHANGES IN ACCELERATION**

GROVER C. PITTS (Virginia, University, Charlottesville) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-137, S-138. refs

The effects of stretch on muscle mass and antigravity and syngavity muscles are investigated using rats, rabbits, guinea pigs, and chickens. It is observed that stretch causes hypertrophy and the absence of stretch results in atrophy; also hypertrophy and atrophy can occur simultaneously at the same joint. The responses of muscles to weightlessness and centrifugation are examined. It is detected that weightlessness causes antigravity muscles to atrophy and syngavity antagonist muscles to hypertrophy; and centrifugation results in stretch with hypertrophy of extensors and shortening with atrophy of flexors. I.F.

**A88-12470#**

### **RECEPTOR MECHANISM AND NEURONAL CIRCUIT SUBSERVING GRAVITATIONAL RESPONSES IN CRAYFISH**

MITUHIKO HISADA, MASAKAZU TAKAHATA, TOSHIKI NAGAYAMA, and MASAMI YOSHINO (Hokkaido University, Sapporo, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-139, S-140. refs

Neural mechanisms underlying the equilibrium reflexes of crayfish are briefly reviewed, with special reference to the gating of the reflex circuit by local nonspiking interneurons. Positional change of the animal body is detected by a pair of statocysts that are specialized equilibrium sense organs in crayfish. Basically, each statocyst transmits information about the magnitude and direction of body tilt within a certain range. Author

**A88-12471#**

### **PHYSIOLOGICAL ROLES OF CALCIUM IN LIGHT-INDUCED GRAVITROPISM IN ZEA PRIMARY ROOTS**

ATSUSHI MIYAZAKI and TADASHI FUJII (Tsukuba University, Sakura, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-141, S-142.

No asymmetric redistribution of plant hormones (indoleacetic acid and abscisic acid) was observed between upper and lower halves of elongation zones during the latent period (0-60 min after stimulation) of the gravitropic response in Zea primary roots. The content of Ca increased in the lower half of horizontally oriented roots which had been briefly exposed to light, while there was no marked difference in the distribution between the upper and lower halves of nonirradiated roots. The Ca increase in the lower half was observed 15-30 min after irradiation in root caps and 30-60 min after irradiation in elongation zones. Author

**A88-12647**

### **BIOPHYSICAL EFFECT OF MICROWAVE RADIATION [BIOFIZICHESKOE DEISTVIE SVCH-IZLUCHENII]**

EL'DER SHAFIEVICH ISMAILOV (United Technologies Corp., Pratt and Whitney, West Palm Beach, FL) Moscow, Energoatomizdat, 1987, 144 p. In Russian. refs

The physical principals of the interaction between microwaves and matter are considered along with the physical-chemical mechanisms for the absorption of microwave energy by biological tissue. Consideration is given to results of studies of the effects of microwaves on cells, subcellular structures, and membranes. Medical applications of microwaves are discussed along with the development of health standards for the use of microwaves. B.J.

**A88-12955****ADAPTATION AND HABITUATION OF MOTION-INDUCED VOMITING IN SQUIRREL MONKEYS**

CHESTER R. WILPIZESKI, LOUIS D. LOWRY, ROBERT A. MILLER, B. DAVISON SMITH, JR., and WENDY GOLDMAN (Thomas Jefferson University, Philadelphia, PA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A22-A28. Research supported by the Ben Franklin Partnership and Thomas Jefferson University. refs (Contract PHS-RR-5414)

Nonrestrained adult squirrel monkeys were found to be prolific vomiters when rotated in the horizontal plane for at least 1 h with visual cues available. When multiple daily spins were given, monkeys who vomited early during the first session tended to habituate during subsequent rotations. Subjects who vomited late during the first spin tended to vomit increasingly earlier for several days before the trend reverted to habituation. Adaptation effects were transient. Author

**A88-12976\*** London Univ. (England).**EFFECTS OF HYPOKINESIA AND HYPODYNAMIA UPON PROTEIN TURNOVER IN HINDLIMB MUSCLES OF THE RAT**

PAUL T. LOUGHNA, DAVID F. GOLDSPIK, and GEOFFREY GOLDSPIK (Royal Veterinary College, London, England; Belfast, Queen's University, Northern Ireland) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A133-A138. refs (Contract NAG2-272)

Hypokinesia/hypodynamia was induced in the hindlimb muscles of the rat, using a suspension technique. This caused differing degrees of atrophy in different muscles. However, this atrophy was reduced in muscles held in a lengthened position. The greatest degree of wasting was observed in the unstretched soleus, a slow postural muscle, where both Type 1 and Type 2a fibers atrophied to the same degree. However, wasting of the gastrocnemius muscle was associated with a reduction in the size of the Type 2b fibers. In both slow-postural and fast-phasic hindlimb muscles, atrophy was brought about by a reduction in the rate of protein synthesis in conjunction with an elevation in the rate of protein degradation. When inactive muscles were passively stretched, both protein synthesis and degradation were dramatically elevated. Even periods of stretch of as little as 0.5 h/d were found to significantly decrease atrophy in inactive muscles. Author

**A88-12978\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.**VASOPRESSIN AND MOTION SICKNESS IN CATS**

R. A. FOX, L. C. KEIL, N. G. DAUNTON, G. H. CRAMPTON, and J. LUCOT (NASA, Ames Research Center, Moffett Field; San Jose State University, CA; Wright State University, Dayton, OH) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A143-A147. refs (Contract NCC2-167; NCC2-220)

Levels of arginine vasopressin (AVP) in blood plasma and cerebrospinal fluid (CSF) were measured in cats under several motion-sickness-inducing conditions. Plasma AVP increased significantly in both susceptible and resistant animals exposed to motion. When vomiting occurred, levels of plasma AVP were dramatically elevated (up to 27 times resting levels). There was no difference in resting levels of AVP of susceptible and resistant cats. Levels of CSF-AVP were not elevated immediately after vomiting, but the testing levels of CSF-AVP were lower in animals that vomited during motion than in those animals which did not

vomit during motion. The results of these experiments show that changes in systemic AVP are directly related to vomiting induced by motion, however, CSF-AVP apparently does not change in association with vomiting. CSF-AVP does appear to be lower in animals that reach frank vomiting during motion stimulation than in animals which do not vomit. Author

**A88-12986****GAIN AND PHASE OF CAT VERTICAL EYE MOVEMENTS GENERATED BY SINUSOIDAL PITCH ROTATIONS WITH AND WITHOUT HEAD TILT**

D. L. TOMKO, C. WALL, III, F. R. ROBINSON, and J. P. STAAB (Pittsburgh, University, PA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A186-A188. refs

Vertical EOGs were recorded in cats during sinusoidal heat pitch from 0.01 to 4.0 Hz with peak velocities of 50 deg/s. The purpose of the experiments was to determine whether dynamic response properties of the vertical vestibuloocular reflex (VOR) elicited by pitch with the animal lying on its side (on-side pitch) differ from those resulting from normal (upright) pitch. During on-side pitch (not changing head position with respect to gravity), the vertical VOR gain was 13.5 percent less than during upright pitch. Thus the vertical VOR was more compensatory than during on-side pitch. Phase did not differ between the two conditions. Author

**A88-12987****AN ANALYSIS OF ASYMMETRIES IN CAT VERTICAL EYE MOVEMENTS GENERATED BY SINUSOIDAL PITCH**

J. P. STAAB, C. WALL, III, F. R. ROBINSON, and D. L. TOMKO (Pittsburgh, University, PA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A189-A191.

Asymmetries in the fast and slow components of nystagmus in the cat vertical vestibulo-ocular reflex (VVOR) were analyzed. Sinusoidal pitch stimuli were used in two experimental conditions, one with the animals on their sides and the other with the animals upright. The half-periods of upward and downward slow component position were generally not of equal duration in the on-side condition. Such was not the case for upright pitch where the slow component was symmetric. In addition, the number of fast components in the two directions was not equal with downward-directed predominating regardless of pitch condition. These two results led to the conclusions that gravity plays an essential role in the normal VVOR and fast component asymmetries may be inherent in the reflex. Author

**A88-12988****EYE MOVEMENTS PRODUCED BY UTRICULAR AND SACCULAR STIMULATION**

IAN S. CURTHOYS (Sydney, University, Australia) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A192-A197. Research supported by the National Health and Medical Research Council of Australia. refs

This study investigated the direction of eye movements produced by localized high frequency electrical stimulation of spots on the utricular and saccular macula in lightly anesthetized guinea pigs using fine bipolar stimulating electrodes to minimize current spread and attempting to keep the other labyrinthine sensory regions functional. Threshold stimulating currents produced upward or upward-torsional movements of the ipsilateral eye. There was no evidence of different directions of eye movements corresponding to different hair cell orientations, nor was there evidence of opposite directions of eye movements produced by stimulation on opposite sides of the striola. These results are not consistent with the

earlier reports of Fluor and Mellstrom (1970 and 1971) and reasons for this conflict are considered. Author

**A88-12991\*** Baylor Univ., Houston, Tex.  
**ROLE OF OTOLITH ENDORGANS IN THE GENESIS OF VESTIBULAR-VISUAL CONFLICT SICKNESS (PITCH) IN THE SQUIRREL MONKEY (FIRST REPORT)**

MAKOTO IGARASHI, TETSUO HIMI, WALTER B. KULECZ, and KAZUTOYO KOBAYASHI (Baylor University, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A207-A211. refs  
 (Contract NAG2-289)

The effects of ablation of the macula utriculi and macula sacculi on vestibular-visual conflict emesis in squirrel monkeys are investigated. An optokinetic drum and a turntable were used for the direction conflict experiment. A significant difference between the preoperative condition and postunilateral and postbilateral utricle-saccullectomy conditions is observed. It is detected that after unilateral saccullectomy the conflict sickness decreases and no emesis occurs; however, 4.5 months after saccullectomy, the animals regain their conflict sickness. The data reveal that macular afferents are important in the genesis of sensory conflict emesis and two submodalities may be needed to cause conflict sickness onset. I.F.

**A88-12997**  
**A NEW ASPECT IN PATHOGENESIS OF EXPERIMENTAL HYDROPS - ROLE OF CALCIUM**

ANGELA M. MEYER ZUM GOTTESBERGE (Duesseldorf, Universitaet, Federal Republic of Germany) and OSAMU NINOYU (Kansai Medical University, Osaka, Japan) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A240-A246. Research supported by the Ministerium fuer Forschung und Wissenschaft des Landes Nordrhein-Westfalen. refs

An imbalanced  $Ca(2+)$  homeostasis in the inner ear was demonstrated using an animal model for Meniere's disease (MD). An increase of  $Ca(2+)$  concentration in the endolymph, as well as in some cells of the inner-ear tissue, causes a rise of osmotic pressure and decrease of electric potential. Based on these results, it is proposed that the common denominator of MD, experimental endolymphatic hydrops, and space motion sickness is primarily a shift of the inner-ear  $Ca(2+)$  homeostasis toward a higher concentration of free  $Ca(2+)$  in the fluid compartments and adjacent intracellular spaces. Author

**A88-12998\*** Pittsburgh Univ., Pa.  
**CAT VESTIBULAR NEURONS THAT EXHIBIT DIFFERENT RESPONSES TO ACTIVE AND PASSIVE YAW HEAD ROTATIONS**

F. R. ROBINSON and D. L. TOMKO (Pittsburgh, University, PA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A247-A249. refs  
 (Contract NAG2-155; NIH-NS-17585)

Neurons in the vestibular nuclei were recorded in alert cats during voluntary yaw rotations of the head and during the same rotations delivered with a turntable driven from a record of previous voluntary movements. During both voluntary and passive rotations, 35 percent (6/17) of neurons tested responded at higher rates or for a larger part of the movement during voluntary movements than during the same rotations delivered with the turntable. Neck sensory input was evaluated separately in many of these cells and can account qualitatively for the extra firing present during active movement. Author

**A88-12999**  
**THE EFFECT OF WEIGHTLESSNESS ON THE FLIGHT BEHAVIOR OF PIGEONS WITH CANAL LESIONS**

W. J. OOSTERVELD and H. A. A. DE JONG (Academisch Medisch Centrum, Amsterdam, Netherlands) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A250-A252. refs

The flight behavior of birds in weightlessness with a loss of labyrinthine function is studied. Normal birds, birds with a blocked anterior canal on one side and a posterior canal on the other, birds with an unilateral labyrinthectomy, and birds with a bilateral labyrinthectomy were examined in a balloon-shaped linen shelter in an aircraft. Normal birds exhibited the tumbling phenomenon; birds with blocked vertical canals showed rotary movements in the plane of the blocked canals; birds with one obstructed labyrinth displayed a barbecue spin rotation with movement directed toward the obstructed labyrinth; and birds with both labyrinths obstructed showed a three phase behavior: a barbecue spin rotation directed towards the most recently obstructed labyrinth, an outside loop, and the tumbling phenomenon. I.F.

**A88-13000**  
**ROTATION TEST IN THE WEIGHTLESS PHASE OF PARABOLIC FLIGHT**

H. A. A. DE JONG and W. J. OOSTERVELD (Academisch Medisch Centrum, Amsterdam, Netherlands) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A253-A256. refs

Human test-persons and pigs were subjected to pendular swing movements during parabolic flight. The rotary-induced nystagmus frequency in pigs increased during a G-load of more than 1.5 G. In the trajectory from zero G to 1.5 G the nystagmus SPV in pigs increased. In human subjects weightlessness suppressed the rotary-induced nystagmus, and gravitational conditions over 2 G increased the nystagmus amplitude. Nystagmus responses in experienced test-persons proved to be independent of changes in G-load. The differences in the results in man and pig support the assumption that rotary-induced nystagmus is not solely a response of the cupulae and the otoliths, but is also affected by tactile and somatosensory stimulation. Author

**A88-13001**  
**ROTATION SPEED OF LABYRINTHECTOMIZED FISH DURING SHORT-DURATION WEIGHTLESSNESS**

JOACHIM WETZIG (Mainz, Universitaet, Federal Republic of Germany) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A257-A261. refs

This study used blind unilaterally labyrinthectomized goldfish of 5 to 15 cm body length. These goldfish were flown in parabolic flights to temporarily effect the loss of the second vestibular apparatus. Flights took place between 1 and 72 h after the operation. Attitude in 3 axes was recorded on video and analyzed from single-frame pictures for speed and direction of rotation about the roll (fish's body longitudinal) axis. Labyrinthectomy resulted in a rotation pattern consistent with literature under normal earth-G conditions. Under diminished G-influence, the rotations, contrary to our expectation, did not stop, but, rather, increased in speed by a factor of 2 to 4. The direction of rotation did not change. The fish readapted to the low-G environment rapidly and returned to the rotation speeds observed before entry into the parabolas during the 5 to 7 s of parabola duration. Current theories for the generation of adaptation are discussed and their merits in explaining the experimental data are compared. Author



**N88-10469#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Hauptabteilung Projekte und Mikrogravitation.

**AQUARACK: AIMS AND POSSIBLE RESEARCH PROJECTS**

Dec. 1986 97 p In GERMAN; ENGLISH summary Lectures presented at the Aquarack Workshop, Cologne, West Germany, 6 Jun. 1986 Report will also be announced as translation (ESA-TT-1083) (DFVLR-MITT-87-01; ISSN-0176-7739; ETN-87-90445) Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The research possibilities offered by the long term maintenance system for aquatic organisms, Aquarack, are discussed. The reproduction biology of the genus *Xiphophorus* was investigated. The *Xiphophorus* system and its possible applications for biological studies in a microgravity environment were examined. Long term investigations of the growth, metabolism, and reproduction of fish under conditions close to weightlessness are proposed. The functional plasticity of the nervous system of vertebrates was investigated. The influence of weightlessness on behavior, reproduction, and metabolism of the freshwater snail *Biomphalaria glabrata* was studied. The usefulness of microalgal structures as an element of closed ecological systems is discussed. The state of the art of space life support systems for biological experiments under weightlessness is surveyed.

ESA

**N88-10470#** Ruhr Univ., Bochum (West Germany). Fakultät fuer Biologie.

**THE AQUARACK AS A POTENTIAL INSTRUMENT FOR BASIC RESEARCH WORK IN SPACE BIOLOGY: INVENTORY AND SCIENTIFIC DISPOSITIONS**

VOLKER BLUEM In DFVLR, Aquarack: Aims and Possible Research Projects p 9-18 Dec. 1986 In GERMAN; ENGLISH summary Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The research possibilities offered by the prototype of a long-term maintenance system for aquatic organisms, Aquarack, are discussed. The construction principles of the Aquarack are described. Three possible levels of scientific work are outlined. The first includes the construction of a prototype and its testing using methods of reproductive and metabolic physiology. The second contains the space-adapted final version within a spacelab and its examinations using developed methods. The last level involves a series of special projects with high scientific value, provided by different users.

ESA

**N88-10471#** Ruhr Univ., Bochum (West Germany). Fakultät fuer Biologie.

**INVESTIGATIONS OF THE SURVEY OF THE REPRODUCTIVE BIOLOGY OF XIPHOPHORUS IN AN AQUARACK**

VOLKER BLUEM and RUEDIGER SCHULZ In DFVLR, Aquarack: Aims and Possible Research Projects p 19-27 Dec. 1986 In GERMAN; ENGLISH summary Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The reproduction biology of the genus *Xiphophorus* was investigated in the long term maintenance system Aquarack. The availability of a long term maintenance system and a successful reproduction in this system are discussed as prerequisites for biological science and for application-oriented research, dealing with boney fish in consecutive generations in a microgravity environment. The particular suitability of the genus *Xiphophorus* as experimental animal is explained, and the most important endocrine system regulating reproduction is outlined.

ESA

**N88-10472#** Giessen Univ. (West Germany). Inst. fuer Genetische.

**XIPHOPHORUS AS AN EXPERIMENTAL SYSTEM FOR GENETIC AND BIOLOGICAL DEVELOPMENT STUDIES UNDER MICROGRAVITY CONDITIONS [XIPHOPHORUS ALS MODELLSYSTEM FUER GENETISCHE UND ENTWICKLUNGSBIOLOGISCHE UNTERSUCHUNGEN IN DER 0-G-UMWELT]**

MARKUS SCHMIDT and FRITZ ANDRES In DFVLR, Aquarack: Aims and Possible Research Projects p 29-36 Dec. 1986 In GERMAN; ENGLISH summary Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The *Xiphophorus* system and its possible applications for biological studies in a microgravity environment were examined. By selective intra and interspecific crossing and backcrossings of wild types and mutants of *Xiphophorus*, an experimental system of 60 different, defined genotypes was constructed. Among these are strains that specifically react by neoplastic transformation after the application of mutagens and differentiation promoters. This and the comprehensive characterization of the system allow a large number of experiments in a space mission to examine the influence of cosmic radiation and weightlessness on genetics, physiology, development, morphology, histology, and cytology of the fish.

ESA

**N88-10473#** Kiel Univ. (West Germany). Inst. fuer Meereskunde.

**LONG TERM INVESTIGATIONS OF THE GROWTH, METABOLISM, AND REPRODUCTION OF FISH UNDER CONDITIONS CLOSE TO WEIGHTLESSNESS**

RAINER FROESE In DFVLR, Aquarack: Aims and Possible Research Projects p 37-45 Dec. 1986 In GERMAN; ENGLISH summary Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The investigation of growth, metabolism, and reproduction of several generations of fish of the genus *Xiphophorus*, in a future space station, is proposed. The different subjects to be investigated are outlined. The proposed materials and methods are presented. The data are planned to be collected indirectly, i.e., by video cameras and photoelectric cells. Cooperation with other research projects is planned. Findings for the development of closed ecological life support systems are expected.

ESA

**N88-10474#** Stuttgart Univ. (West Germany). Inst. fuer Zoologie.

**FUNCTIONAL PLASTICITY OF THE NERVOUS SYSTEM OF VERTEBRATES**

HINRICH RAHMANN and WOLFGANG PROBST In DFVLR, Aquarack: Aims and Possible Research Projects p 47-59 Dec. 1986 In GERMAN; ENGLISH summary Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The development, behavior, and adaptability of the central nervous system (CNS) of fishes, especially the tectum opticum, were investigated using optical and electron microscopes, as well as biochemical methods. Following light versus dark rearing, and adaptation to the cold versus warmth, an ultra structural neuronal plasticity is observed, especially concerning the sites of synapses. Synapses with different activity can be determined by different enrichments of extracellular calcium in the synaptic cleft and by the ultracytochemical observation of the activity of the doubly-ionized-Ca-ion-ATPase in the CNS. Using such ultra structural parameters, the influence of microgravity on the structure and function-related neuronal plasticity of the CNS of vertebrates can be investigated during the early ontogenetic development as well as in the adult state.

ESA

## 51 LIFE SCIENCES (GENERAL)

**N88-10475#** Hamburg Univ. (West Germany). Inst. fuer Zoologie.

### **THE INFLUENCE OF WEIGHTLESSNESS ON THE METABOLISM OF THE BIOMPHALARIA GLABRATA**

WILHELM BECKER /in DFVLR, Aquarack: Aims and Possible Research Projects p 61-68 Dec. 1986 In GERMAN; ENGLISH summary

Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The influence of weightlessness on behavior, reproduction, and metabolism of the freshwater snail *Biomphalaria glabrata* (Pulmonata) was investigated. A method for the continuous recording of heartbeat frequency and heart minute volume in the uninjured animal was developed and successfully tested under gravity conditions. The results are planned to be used to determine the effect of the gravitational force on the open circulatory system of this snail. ESA

**N88-10476#** Bonn Univ. (West Germany). Inst. fuer Botanik.

### **THE USEFULNESS OF MICROALGAL STRUCTURES AS AN ELEMENT OF CLOSED ECOLOGICAL SYSTEMS LIKE AQUARACK AND CELSS**

KARLHEINZ KREUZBERG /in DFVLR, Aquarack: Aims and Possible Research Projects p 69-76 Dec. 1986 In GERMAN; ENGLISH summary

Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The usefulness of continuous cultures of green algae, such as *Scenedesmus*, *Chlorella*, *Chlamydomonas*, and *Chlorogonium*, was examined with respect to the regeneration of oxygen and the reamassimilation of CO<sub>2</sub> and ammonia. The most important advantages of microalgal cultures are a low demand of space, controlled and selfregulated cell growth, high metabolism rates, efficient energy transfer, a well balanced carbon and nitrogen recovery, and suitability for human food. Further investigations for the development of a practicable algal module for closed ecological systems are proposed. ESA

**N88-10477#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

### **LIFE SUPPORT SYSTEMS FOR BIOLOGICAL EXPERIMENTS UNDER WEIGHTLESSNESS IN THE GERMAN AND EUROPEAN SPACE PROGRAMS**

WOLFRAM LORK and RAINER STOEPLER /in DFVLR, Aquarack: Aims and Possible Research Projects p 77-93 Dec. 1986 In GERMAN; ENGLISH summary

Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 33.50

The state of the art of space life support systems is surveyed. The tendency to the development of closed loop systems is emphasized. The configuration of several life support systems, such as the Spacelab Environmental Control and Life Support System, biorack and biological incubators, a botany facility and solar plant growth facility, a fish incubator, the Environmental Life Support System and Biological Life Support System, the Controlled Ecological Life Support Systems, and Aquarack, is described. Proposals for further research are given. ESA

**N88-10848\*#** Tennessee Technological Univ., Cookeville.

### **RAPID TOXICITY DETECTION IN WATER QUALITY CONTROL UTILIZING AUTOMATED MULTISPECIES BIOMONITORING FOR PERMANENT SPACE STATIONS**

E. L. MORGAN, R. C. YOUNG, M. D. SMITH (Tennessee Valley Authority, Knoxville.), and K. W. EAGLESON /in NASA- Goddard Space Flight Center, Greenbelt, Md. Fourteenth Space Simulation Conference: Testing for a Permanent Presence in Space p 227-235 1986

Avail: NTIS HC A19/MF A01 CSCL 06B

The objective of this study was to evaluate proposed design characteristics and applications of automated biomonitoring devices for real-time toxicity detection in water quality control on-board permanent space stations. Simulated tests in downlinking transmissions of automated biomonitoring data to Earth-receiving

stations were simulated using satellite data transmissions from remote Earth-based stations. Author

**N88-11365#** Louisiana State Univ., Baton Rouge.

### **A PHYSICO-CHEMICAL STUDY OF SOME AREAS OF FUNDAMENTAL SIGNIFICANCE TO BIOPHYSICS Annual Report, 1986-1987**

S. P. MCGLYNN 1 Jul. 1987 57 p

(Contract DE-FG05-87ER-60503)

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The thirteen (13) titles (Nos. 283 to 295) of the Bibliography for the 1986 to 1987 Annual Report constitute the gist of this document. These titles represent work completed and published (or in process of publication). The scientific report which follows is intended to provide a brief summary of the ongoing research efforts of the Molecular Spectroscopy Group. The titles covered are as follows: Rare Gas Density Effects on High-M Rydberg States, Electric Field Dependence of the Total Excimer Luminescence of Xenon Excited Below the Atomic Ionization Limit, Term Value/Band-Gap Energy Correlations for Solid Rare Gas Excitons, Laser Optogalvanic Spectroscopy of Iodine and Cesium, Photoionization Spectroscopy of Highly Polar Aromatics, and Photochemistry of Polyatomic Molecules. There are six individual papers listed separately in this report. DOE

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### **AEROSPACE MEDICINE**

Includes physiological factors; biological effects of radiation; and weightlessness.

**A88-10220**

### **ENERGY HOMEOSTASIS AND ADAPTATION CAPABILITIES OF MAN IN EXTREME CONDITIONS [ENERGETICHESKII GOMEOSTAZ I ADAPTATSIONNYE VOZMOZHNOSSI CHELOVEKA V EKSTREMAL'NYKH USLOVIYAKH]**

A. F. KONKOVA, I. A. MAGAI, O. M. SHEKHAEVA, V. F. SOKOLOV, and M. N. ANUFRIEVA (AN SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR) Akademiia Nauk SSSR, Izvestiia, Seria Biologicheskaiia (ISSN 0002-3329), July-Aug. 1987, p. 506-518. In Russian. refs

The paper considers the status of the energy homeostasis of an organism under extreme conditions. It is shown that total entropy changes of a metabolic system and changes in the entropy of internal and external environments and of their rate parameters under conditions of adequate and inadequate adaptive metabolic reactions to the external stress are determined by the rate of the heat flow from the organism to the environment and by the efficiency of the coordination of the metabolic processes. This in turn depends on the condition of the phosphate potential. The interrelation between the changes in the entropy parameters and the changes in phosphate potential processes determines the state of energy homeostasis as a condition of the fitness of an organism under stress. I.S.

**A88-10222**

### **INVESTIGATION OF CORTICAL ELECTRICAL ACTIVITY AND OF THE TIME OF RESPONSE TO SOUND AND LIGHT STIMULI [ISSLEDOVANIIE ELEKTRICHESKOI AKTIVNOSTI KORY I VREMENI REAKTSII NA ZVUKOVYE I SVETOVYE STIMULY]**

V. F. KONOVALOV, A. I. FEDOTCHEV, and A. T. BONDAR' (AN SSSR, Institut Biologicheskoi Fiziki, Pushchino, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 73, June 1987, p. 698-707. In Russian. refs

The electrical activity of the occipital, sensorimotor, and frontal zones of the left and right cerebral hemispheres was measured together with the time of bimanual motor responses in normal adults subjected to sequential series of sound, light, and sound



signals (11 in each series) administered with an increasing (from 15 to 25 Hz) and decreasing (from 15 to 5 Hz) frequency. Both nonspecific and specific (i.e., depending upon the parameters of the stimuli) responses were observed. It was found that light stimuli caused more pronounced delays in manual responses than sound signals. Light stimuli presented in the mode of increasing frequencies were more effective than the decreasing-frequency stimuli, causing more pronounced alpha-range oscillations in brain activity and significant changes in the asymmetry of bimanual motor responses. The physiological reactions of subjects were also found to depend upon their subjective condition; stimuli increasing in frequency affected the emotional status of subjects more adversely than the decreasing-frequency stimuli. I.S.

#### A88-11722

##### **PREDICTION OF THE INCIDENCE OF MOTION SICKNESS FROM THE MAGNITUDE, FREQUENCY, AND DURATION OF VERTICAL OSCILLATION**

ANTHONY LAWTHORP and MICHAEL J. GRIFFIN (Southampton, University, England) Acoustical Society of America, Journal (ISSN 0001-4966), vol. 82, Sept. 1987, p. 957-966. refs

#### A88-12107

##### **ASSESSMENT OF THE FUNCTIONAL RESERVES OF AN ORGANISM [K OTSENKE FUNKTSIONAL'NYKH REZERVOV ORGANIZMA]**

V. V. PASTUKHOV, N. N. PLAKHOV, and Z. K. SULIMO-SAMUILLO Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), May 1987, p. 38, 39. In Russian.

The role of preliminary tests to assess functional reserves in individuals assigned for work under stressful physical or environmental conditions is discussed. Special consideration is given to particular physiological tests which make it possible to identify individuals with low levels of functional reserves. These workers must be given training consisting of gradual exposures to the particular type of the occupational/environmental stress to which they will be subjected in the future. It was shown that such preliminary training is very effective in ameliorating changes in cardiorespiratory indices that characterize physical stress and/or exhaustion. I.S.

#### A88-12108

##### **CORRELATION BETWEEN SOME INDICES OF MICROELEMENT METABOLISM, VITAMIN-C SUFFICIENCY, AND IMMUNE PROTECTION OF AN ORGANISM [O KORRELIATSII MEZDU NEKOTORYMI POKAZATELIAMI OBmena MIKROELEMENTOV, C-VITAMINNOI OBESPECHENOSTI I IMMUNNOI ZASHCHITY ORGANIZMA]**

V. V. NASOLODIN, V. IA. RUSIN, and V. A. SUVOROV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), May 1987, p. 40-42. In Russian. refs

Correlations between the characteristics of iron and copper metabolism on the one hand and indices of vitamin-C sufficiency and immunity status on the other were investigated in 28 young human subjects. A table is presented showing the correlation coefficients for various combinations of the following factors analyzed in these subjects: plasma and/or blood-cell concentrations of iron, copper, hemoglobin, peroxidase, lysozyme, erythrocytes, alpha-globulin, complement, and vitamin-C. Evidence concerning the effects of vitamin-C, Fe, and/or Cu insufficiency is discussed.

#### A88-12110

##### **EFFECT OF ACUPUNCTURE ON THE GENERAL STABILITY OF THE ORGANISM AND ON THE WORK CAPACITY OF SEAMEN [VLIANIE IGLOREFLEKSOTERAPII NA NESPETSIFICHESKUII USTOICHIVOST' ORGANIZMA I RABOTOSPOBNOST' MORIAKOV]**

A. A. ARZUMANOV and V. N. BORTNOVSKII Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), May 1987, p. 46. In Russian.

#### A88-12320

##### **OZONE EXPOSURE ALTERS TRACHEOBRONCHIAL MUCOCILIARY FUNCTION IN HUMANS**

W. MICHAEL FOSTER, D. L. COSTA, and E. G. LANGENBACK (New York, State University, Stony Brook; USVA, Medical Center, Northport) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Sept. 1987, p. 996-1002. USVA-supported research. refs (Contract NIH-RO1-HL-31429-03)

The effect of chamber exposure to concentration of ozone within the ranges commonly recorded during urban pollution on the airway mucociliary function was determined in nonsmokers, using noninvasive techniques to measure deposition and retention of insoluble radiolabeled particles on airway mucous membranes. Exposure to 0.4 ppm ozone caused reduction in particle retention, which was coincident with impaired lung function. Peripheral mucus flow into central bronchi was increased after 2 h of 0.2 ppm ozone and may indicate an early response by the lung to ozone at a concentration which, while it exceeds the limit established under the Clean Air Act, is often imposed on one-third of the urban population of the United States. I.S.

A88-12321\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

##### **CONTINUOUS MONITORING OF BLOOD VOLUME CHANGES IN HUMANS**

H. HINGHOFER-SZALKAY and J. E. GREENLEAF (NASA, Ames Research Center, Moffett Field, CA; Graz, Universitaet, Austria) Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Sept. 1987, p. 1003-1007. Research supported by the Oesterreichische Akademie der Wissenschaften. refs (Contract NASA TASK 199-21-12-07)

Use of on-line high-precision mass densitometry for the continuous monitoring of blood volume changes in humans was demonstrated by recording short-term blood volume alterations produced by changes in body position. The mass density of antecubital venous blood was measured continuously for 80 min per session with 0.1 g/l precision at a flow rate of 1.5 ml/min. Additional discrete plasma density and hematocrit measurements gave linear relations between all possible combinations of blood density, plasma density, and hematocrit. Transient filtration phenomena were revealed that are not amenable to discontinuous measurements. I.S.

#### A88-12323

##### **EFFECT OF BRAIN BLOOD FLOW ON HYPOXIC VENTILATORY RESPONSE IN HUMANS**

M. NISHIMURA, A. SUZUKI, Y. NISHIURA, H. YAMAMOTO, K. MIYAMOTO (Hokkaido University, Sapporo, Japan) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 63, Sept. 1987, p. 1100-1106. refs

The effect of brain blood flow on hypoxic ventilatory response was assessed by simultaneously measuring arterial and internal jugular venous blood gases and ventilation in healthy male humans subjected to either progressive and subsequently sustained hypoxia or to stepwise and progressive hypercapnia. A withdrawal test (modified transient O<sub>2</sub> test) was performed on another day. The average of the estimated depressant effect due to increased brain blood flow in progressive isocapnic hypoxic ventilatory response was about 122 percent of the original response. The value of the withdrawal test correlated significantly with the hypoxic response in each subject. The results suggest that the wide interindividual variation of the hypoxic response that was observed more likely depends on the activity originated from the peripheral chemoreceptor rather than the magnitude of central depressant effects due to the change of brain blood flow. I.S.

**A88-12324****CARDIOVASCULAR RESPONSES TO MILITARY ANTISHOCK TROUSER INFLATION DURING STANDING ARM EXERCISE**

ALEXANDER V. NG, PETER HANSON, ELIZABETH A. AARON, ROGER B. DEMMENT, JASON M. CONVISER (Wisconsin, University, Madison) et al. *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Sept. 1987, p. 1224-1229. refs

The effect of lower-body positive pressure on the hemodynamic variables of cardiac output, i.e., heart rate (HR), stroke volume (SV), blood pressure, total peripheral resistance (TPR), and O<sub>2</sub> consumption were determined in healthy males wearing military antishock trousers (MAST) inflated to 50 mm Hg. Subjects were studied while standing at rest and at 25, 50, and 75 percent of maximal arm-cranking O<sub>2</sub> consumption. MAST inflation resulted in an increase in SV and cardiac output during rest and during arm-cranking exercise at 32, 50, and 71 percent maximal arm-cranking O<sub>2</sub> consumption. There were no differences, however, in the oxygen consumption or in the cardiac output-to-oxygen-consumption ratios between the inflated and control conditions. I.S.

**A88-12427#****MECHANISMS OF ACUTE AND CHRONIC EFFECTS OF MICROGRAVITY**

O. G. GAZENKO, A. I. GRIGOR'EV, and I. B. KOZLOVSKAIA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-1 to S-5. refs

The intrinsic mechanisms responsible for homeostasis in altered gravity fields are examined with respect to specific adaptation processes in motor systems and in systems of neuro-humoral regulation. The data reviewed indicate the complexity of these mechanisms and their heterogeneous and sometimes opposite character at different stages of exposure to microgravity, and show significant differences in the mechanisms of the acute and the delayed adaptive responses. The results are interpreted in the framework of a hypothesis, according to which these processes occur as independent reactions controlled by different systems and induced by different triggers: (1) by microgravity that causes immediate, acute reactions and (2) by microgravity-induced variations in the inner medium that lead to delayed (secondary) reactions. I.S.

**A88-12429#****THE ESA ANTHORACK PROJECT - INTEGRATED RESEARCH IN HUMAN PHYSIOLOGY**

D. LINNARSSON (Karolinska Institutet, Stockholm, Sweden) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-10 to S-12.

The ESA project for studying human physiology under the conditions of space flight, termed Anthorack, is discussed. Consideration is given to the projected experiments, which will study the control of balance and locomotion, cardiovascular dynamics, endocrine responses to fluid and blood shifts, pulmonary function, and metabolism, as well as to the hardware involved in the project. The first flight opportunity for the Anthorack experiments will be with the Spacelab flight D-2 in the early 1990's. I.S.

**A88-12430#****THE EFFECT OF HEAD-DOWN TILT ON THE EEG RESPONSE TO MENTAL ARITHMETIC (MA)**

JINHE WEI, GONGDONG YAN, ZHIQIANG GUAN, and XIANYUN SHEN (Institute of Space Medico-Engineering, Beijing, People's Republic of China) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-13, S-14.

The effect of weightlessness on the status of brain function was investigated by comparing the responses of EEG spectra to mental arithmetic performed during 45-deg head-up tilt (HUP) with those performed during 10-deg head-down tilt (HDT). It was found that the increase, from the base level, of the EEG activity occurring during the performance mental arithmetic was significantly less during HDT than during HUT, especially at the scalp area corresponding to right associate cortex. It is suggested that the responsiveness of brain declines during HDT, and that the status of the brain function, especially in the posterior right brain, is readjusted during the exposure to weightlessness. I.S.

**A88-12433#****PHYSIOLOGICAL LIMITATIONS OF HUMAN TOLERANCE TO GZ ACCELERATION**

ULF I. BALDIN (Karolinska Institutet; Forsvarets Forskningsanstalt, Stockholm, Sweden) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-23 to S-26. refs

High-performance aircraft of today may expose the pilot to rapid-onset (up to 6 G/s) high (up to 9 G) sustained G-loads. This paper discusses the physiological limitations of human tolerance to Gz acceleration, the precautions that can be followed to help prevent the G-induced loss of consciousness, and the measures that can be taken in the event of its occurrence. Consideration is given to great variability in Gz tolerance in different subjects and in the same subject under different conditions; the predictors of good future tolerance in an individual; the environmental factors affecting Gz tolerance; and to the exercises, voluntary straining maneuvers, and devices that can raise tolerance. It is suggested that in an event of consciousness loss during rapid acceleration, an autopilot system should be available to temporarily take over the controls of the aircraft. I.S.

**A88-12436#****CENTRAL CIRCULATION DURING EXPOSURE TO 7-DAY MICROGRAVITY (HEAD-DOWN TILT, IMMERSION, SPACE FLIGHT)**

V. E. KATKOV, L. I. KAKURIN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), V. V. CHESTUKHIN (Nauchno-Issledovatel'skii Institut Transpantologii i Iskusstvennykh Organov, Moscow, USSR), and K. KIRSCH (Berlin, Freie Universitaet, Federal Republic of Germany) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-36 to S-41. refs

The effects of simulated-microgravity exposure by 7 days of 15-deg head-down tilt (HDT) or water immersion on central circulation were investigated and compared. It was found that in the first 7 hours of exposure, the effects on the parameters of central circulation were more distinct in immersion than in HDT. The circulation parameters ceased to change on test days 2 or 3, and the absolute values of most circulation parameters became identical by the end of both exposures. The CVP measured during space flights was found to agree closely with the values measured during both simulations. I.S.

**A88-12437#****HORMONAL REGULATION IN SPACE FLIGHTS OF VARYING DURATION**

I. A. POPOVA, B. V. AFONIN, N. A. DAVIDOVA, and A. I. GRIGOR'EV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-42 to S-44. refs

Changes in the blood content of various hormones and in the responses of target organs to each of these hormones were studied as functions of the space-flight time, using data obtained during the short-term and the prolonged space flights. It was found that flights of up to 14-day duration induce a moderate stress on the sympatho-adrenal system, but the effect of catecholamines at the tissue level remains adequate. The long-term flights, on the other hand, lead to changes that suggest a reduction of the functional activity of receptors in response to space flight effects. Similar changes were detected in prolonged bed rest studies; cell sensitivity to hormones varied in the fashion observed in weightlessness.

I.S.

**A88-12439#****BODY IMPEDANCE MEASUREMENT DURING SPACELAB MISSION D1**

F. BAISCH and L. BECK (DFVLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-47, S-48. refs

Body fluid redistribution and loss during space flight was investigated along with the effects on the heart. The impedance of two body segments (Z-torso and Z-body) to a 100-kHz 1-mA constant current, the first derivative of the torso segment, and the ECG were recorded with a 24-h personal recorder. Data were obtained from two astronauts during launch and reentry, and during the flight from another two. The recumbent period prior to launch is decisive for fluid redistribution in the compartments covered by this method. The amount of fluid shifted is comparable to that produced by daily positional changes. A fluid loss of about 2.5 liters can be inferred from the values of Z-body and anthropometric factors. Cardiac output, as assessed by  $dZ/dt$ , was increased by more than 30 percent of control even on inflight day 2; on day 4 its values were, however, lower than preflight. Heart rate and its variability strongly suggest increased cardiac parasympathetic activity.

Author

**A88-12440#****MAGNETIC EFFECT ON CARDIOPULMONARY FUNCTION IN MAN**

OSAMU OKAI (Kyorin University, Hachioji, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-49, S-50.

The effect of a magnetic field on pulmonary function was investigated, using human subjects placed between the poles of a magnet whose maximum field intensity could be varied. The subjects were requested to maintain voluntary apnea by holding their breath for 30 sec, while their oxygen saturation curve, ECG, pulse wave, and respiratory wave were recorded. During apnea, the mean time ECG exhibited no change, the amplitude of the pulse wave was reduced, and the respiratory wave did not appear. The oxygen saturation curve descended to the minimum point of oxygen saturation, and, thereafter, ascended to the normal level. The application of a magnetic field of 1.2 kg caused a significant fall in the oxygen saturation decrease ratio. The results are attributed to the fact that the magnet attracts oxygen and deoxyhemoglobin, but not oxyhemoglobin, which gravitates downward.

I.S.

**A88-12443#****CARDIOVASCULAR RESPONSES DURING 70 DEG HEAD-UP TILT - THE EFFECT OF ELEVATED BODY TEMPERATURE AND HIGH ALCOHOL BLOOD LEVELS**

I. B. MEKJAVIC, C. A. GAUL, M. D. WHITE, and K. D. MITTLEMAN (Simon Fraser University, Burnaby, Canada) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-56, S-57. Research supported by the Simon Fraser University. refs

The effects of elevated body temperature and alcohol on the blood pressure, stroke volume, and heart rate of humans subjected to head-up tilt (HUT) were investigated in subjects who had either ingested 2.5 ml of 40-percent alcohol or had undergone immersion for 60 min in a 40-deg C bath prior to being placed on a tilt table and, after 5 min in the horizontal position, subjected to a 70-deg HUT. The results showed a reduction (by alcohol) in mean arterial blood pressure (which rises in response to HUT) with a concomitant rise in heart rate, indicating that alcohol acts synergistically with elevated body temperature in increasing peripheral perfusion by decreasing peripheral resistance.

I.S.

**A88-12445#****THE EFFECT OF BODY POSITION ON VENTILATION AND PERFUSION IN THE LUNG**

E. MORIYA, K. KAWAKAMI, M. SUDOH, and S. IKAWA (Jikei University, Tokyo, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-60, S-61.

The effects of 45-deg head-up tilt (HUT) and 45-deg head-down tilt (HDT) on the parameters of lung ventilation and perfusion were investigated. Pulmonary pulses, base transthoracic impedance, and cardiac output were measured in six healthy men, and total peripheral resistance was calculated from cardiac output and blood pressure; changes in pulmonary blood volume were measured using Tc-99-labeled RBCs. Compared to supine position, HUT and HDT (less significantly than HUT) increased blood pressure; HUT resulted in significant decrease in the cardiac output. As a result, total peripheral resistance in HUT remained higher than in the other two positions. On the other hand, the HDT caused a significant decline in blood gas, implying that some unknown changes have occurred in the pulmonary-circulatory system.

I.S.

**A88-12446#****EFFECTS OF GRADED HEAD-UP TILTING ON MUSCLE SYMPATHETIC ACTIVITIES IN MAN**

SATOSHI IWASE, TADAOKI MANO, and MITSURU SAITO (Nagoya University, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-62, S-63. refs

The effect of graded (every 5-10 deg) head-up tilting, from the supine position to 90 deg, on the discharge responses of sympathetic nerve fibers of skeletal musculature was investigated in human subjects, using a tungsten microelectrode inserted into the tibial nerve and a neuromicrograph. During the tilting, muscle sympathetic nerve activity (MSA), expressed as burst rate increased. The MSA increased when the arterial blood pressure (ABP) decreased, and became silent when ABP increased. A significant positive linear correlation was established between the sine of the tilting angle and the MSA burst rate. It is concluded that the changes of MSA burst with head-up tilting may be related to the homeostatic mechanism for the maintenance of systemic blood pressure during gravity changes.

I.S.

**A88-12447#****CARDIOVASCULAR EFFECTS OF HEAD-UP TILT AS AFFECTED BY A VASOPRESSIN ANALOGUE**

ROMAN BAER, OLA EIKEN, and ULF BALLDIN (Karolinska Institutet, Stockholm, Sweden) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-64, S-65. refs

The effect of triglycyllysine-vasopressin (TGLVP) on cardiovascular responses to head-up tilt (HUT) were investigated in humans subjected to 20 min of 70-deg HUT. In supine subjects, an intravenous dose of 50 mEq/kg body weight of TGLVP induced an increase in mean arterial pressure, a drop of heart rate (HR), and a rise in total peripheral resistance (TRP), with no change in stroke volume (SV). During the HUT, the TGLVP caused an exaggerated curtailment of SV, an exaggerated fall in cardiac output, and an exaggerated increase of TRP values, as compared to placebo; head-up values for HR were not altered by TGLVP. In the post-tilt period the TRP of the TGLVP-injected subjects remained significantly higher than in the placebo controls, an indication of the prolonged action of the drug. I.S.

**A88-12448#****TEN-DEGREE HEAD-DOWN AND -UP TILTING ON THE WATER INTAKE AND CARDIOVASCULAR RESPONSES DURING MILD EXERCISE IN WOMAN**

KIKUKO YOKOZAWA, SHIGEYO TORIKOSHI, MIYAKO INAZAWA (Tokyo Women's Christian University, Japan), KATSUKO ITOH (Tsurumi University, Japan), YASUKO FUKASE (Rikkyo Saint Marguerite Women's College, Japan) et al. (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-66, S-67.

The effects of head-up tilt (HUT) and head-down tilt (HDT) on water intake and cardiovascular responses during mild exercise were investigated in female subjects performing a 300 kpm/min pedaling exercise in 10-deg or -10-deg tilts. Water intake at 50 min of exercise was 14 percent lower in HDT than in HUT. Mean arterial blood pressure (MAP), cardiac output, stroke volume (SV), and forearm blood flow (FBF) measured just before drinking water were significantly lower in HDT than in HUT, although VO<sub>2</sub>, heart rate, skin temperature, and audiotmus temperature were not different. Water intake was significantly correlated to the values of SV, FBF, and arteriovenous oxygen difference (but not to the MAP). The results indicate that the increase in central blood volume inhibits water intake during mild exercise in HDT. I.S.

**A88-12449#****CARDIOVASCULAR RESPONSES OF AGED MEN TO ORTHOSTATISM DURING HEAT EXPOSURE**

K. SHIRAKI, S. SAGAWA, M. K. YOUSEF, N. KONDA, and K. MIKI (University of Occupational and Environmental Health, Kitakyushu, Japan; Nevada, University, Las Vegas) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-68, S-69. Research supported by the University of Occupational and Environmental Health. (Contract NIH-1-R15-AG-06074-01)

The effect of age on cardiovascular responses to passive tilting was investigated using six old (61-73 yr) and ten young (21-39 yr) men. Experiments were carried out at 26 C and after acute exposure to 40 C. Continuous measurements of esophageal and skin temperatures and heart rate were made. Blood pressure, forearm blood flow, and cardiac output were measured at 4-5-min intervals. Measurements were made in supine position and after 70-deg head-up tilt for 15 min. Cardioacceleration during the tilt test was greater in the young than in the old. Old men did not show significant decrease in forearm blood flow during tilting, suggesting a possible defect in the sympathetic nervous reflex. However, other circulatory adaptations seem to overcome this deficiency, resulting in orthostatic tolerance similar to that of the young. During

head-up tilt at 26 and 40 C, the esophageal temperature in the old responded differently, which may suggest an alteration of blood flow distribution. Author

**A88-12450#****EFFECTS OF LBPP STOCKING ON CARDIOVASCULAR RESPONSES DURING REST AND EXERCISE IN LBNP AND UPRIGHT POSITION IN WOMAN**

JUNKO NAGANO (Bunka Women's University, Tokyo, Japan), SHIGEYO TORIKOSHI, KIKUKO YOKOZAWA, MIYAKO IONAZAWA (Tokyo Women's Christian University, Japan), KATSUKO ITOH (Tsurumi University, Japan) et al. (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-72, S-73.

The effect of wearing a lower body positive-pressure stocking (LBPPS) with about 20-mm Hg pressure on cardiovascular responses during rest and exercise (pedaling or treadmill running) was investigated in young women subjected to lower-body negative pressure (LBNP). Systolic and diastolic arterial pressures (SAP and DAP, respectively), pulse pressure (PP), cardiac output (CO), stroke volume (SV), and arteriovenous (A-V) O<sub>2</sub> difference were measured at rest, exercise, and recovery. Wearing the LBPPS resulted in lower HR and PP, indicating that the positive pressure was accelerating venous return. In addition, during the exercise, the LBPPS effected increases in CO and SV and a decrease in A-V O<sub>2</sub> difference. The results demonstrated that the 20-mm Hg lower-body positive pressure lowers the defensive cardiovascular responses to gravity stimulation. I.S.

**A88-12451#****EFFECTS OF LEAN BODY MASS AND AEROBIC POWER ON LBNP TOLERANCE IN WOMAN**

SHIGEYO TORIKOSHI, KIKUKO YOKOZAWA, MIYAKO INAZAWA (Tokyo Women's Christian University, Japan), KATSUKO ITOH (Tsurumi University, Japan), YASUKO FUKASE (Rikkyo Saint Marguerite Women's College, Japan) et al. (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-75, S-76. Author

**A88-12463#****METABOLIC ADAPTATION IN HYPOKINESIA IN HUMANS**

H. SAIKI (Saint Marianna University, Kawasaki, Japan), J. NAKAJIMA, M. NAKAYA, Y. SUGITA, and M. SUDOH (Jikei University, Tokyo, Japan) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-121 to S-124. refs

The relation between chronophysiological rhythm and adaptation to a hypogravic environment is studied. Three healthy male adults were subjected to 6 days of thermal neutral water immersion. Changes in the circadian rhythms of urinary excretion of minerals and hormones are examined. Particular attention is given to the excretion of urine, Na(+), 17-OHCS, adrenalin, noradrenalin, and K(+). The fluctuations in the distribution patterns of each sleep stage before, during, and after water immersion are analyzed. It is observed that new steady states for urine volume and urinary excretion of Na(+) are attained during the water immersion conditioning; steady states for urinary excretion of 17-OHCS, adrenalin, and noradrenalin are obtained at the control level, and no steady state is attained for K(+) during the immersion period. I.F.

**A88-12464#****CONTROLLED WATER IMMERSION AS A MODEL OF WEIGHTLESSNESS**

I. D. PESTOV and A. V. POKROVSKII (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-125 to S-128.

The use of a controlled water immersion model to simulate weightlessness is examined. The control parameter for the model is a variable level of hydrostatic pressure exerted by the immersion medium on the lower body; methods for achieving this effect are discussed. The capabilities of the model are described. Some data derived using the model are presented. The controlled water immersion model is applicable to: a short-time simulation of qualitatively different states of gravity tolerance; a study of the cause/effect relationship between controlled changes in the blood distribution pattern and resulting reactions; and an analysis of space physiology problems. I.F.

**A88-12472#****CARDIOVASCULAR RESPONSES TO CENTRAL HYPOVOLEMIA IN MAN - PHYSIOLOGY AND PATHOPHYSIOLOGY**

T. BENNETT (Queen's Medical Centre, Nottingham, England) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-143 to S-146. refs

Cardiovascular and hormonal responses to lower body negative pressure (LBNP) are examined. Afferent and efferent relations in human cardiovascular reflex responses to central hypovolemia are studied. It is observed that exposure to low levels of LBNP causes a reduction in central venous pressure, forearm vasoconstriction with little increase in splanchnic vascular resistance, no tachycardia, and no changes in systemic arterial systolic or diastolic blood pressure; and high levels of LBNP cause a reduction in central venous and systemic arterial blood pressure, forearm and splanchnic vasoconstriction, and tachycardia. Cardiovascular processes in patients with various pathophysiological conditions, such as orthostatic hypotension and diabetic autonomic neuropathy, are also investigated. I.F.

**A88-12473#****THE EFFECTS OF EXERCISE TRAINING ON FACTORS AFFECTING ORTHOSTATIC TOLERANCE**

PETER B. RAVEN, MICHAEL L. SMITH, DONNA L. HUDSON, and HOWARD M. GRAITZER (Texas College of Osteopathic Medicine, Fort Worth) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) *Physiologist, Supplement* (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-147 to S-150. refs (Contract F33615-85-C-14511)

The physiological responses during lower body negative pressure to -40 torr on three distinct groups of subjects with full cardiac efferent autonomic blockade using metoprolol tartrate and atropine sulfate are studied. The three groups of subjects were: (1) untrained, (2) dynamically endurance trained, and (3) weight trained. Changes from 0 to -40 torr in heart rate, systolic blood pressure, and forearm vascular resistance for the three groups during controlled and blocked conditions are analyzed and compared. The indices of baroreflex responsiveness for the three groups are estimated. The data reveal that endurance training significantly attenuates baroreflex responsiveness to a hypotensive challenge; however, heavy resistance weight training has little effect on the baroreflex. I.F.

**A88-12490\* McGill Univ., Montreal (Quebec).****NONLINEAR DYNAMICS, CHAOS AND COMPLEX CARDIAC ARRHYTHMIAS**

L. GLASS, M. COURTEMANCHE, A. SHRIER (McGill University, Montreal, Canada), and A. L. GOLDBERGER (Beth Israel Hospital, Boston, MA) (Royal Society, Discussion on Dynamical Chaos, London, England, Feb. 4, 5, 1987) *Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences* (ISSN 0080-4630), vol. 413, no. 1844, Sept. 8, 1987, p. 9-26. Research supported by the Canadian Heart Foundation, NSERC, and NASA. refs

Periodic stimulation of a nonlinear cardiac oscillator in vitro gives rise to complex dynamics that is well described by one-dimensional finite difference equations. As stimulation parameters are varied, a large number of different phase-locked and chaotic rhythms is observed. Similar rhythms can be observed in the intact human heart when there is interaction between two pacemaker sites. Simplified models are analyzed, which show some correspondence to clinical observations. Author

**A88-12951\*****PHYSIOLOGIC ADAPTATION OF MAN IN SPACE; PROCEEDINGS OF THE SEVENTH INTERNATIONAL MAN IN SPACE SYMPOSIUM, HOUSTON, TX, FEB. 10-13, 1986**

ALBERT W. HOLLAND, ED. Symposium sponsored by NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics. *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, 288 p. For individual items see A88-12952 to A88-13004.

Topics discussed in this volume include space motion sickness, cardiovascular adaptation, fluid shifts, extravehicular activity, general physiology, perception, vestibular response modifications, vestibular physiology, and pharmacology. Papers are presented on the clinical characterization and etiology of space motion sickness, ultrasound techniques in space medicine, fluid shifts in weightlessness, Space Shuttle inflight and postflight fluid shifts measured by leg volume changes, and the probability of oxygen toxicity in an 8-psi space suit. Consideration is also given to the metabolic and hormonal status of crewmembers in short-term space flights, adaptive changes in perception of body orientation and mental image rotation in microgravity, the effects of a visual-vestibular stimulus on the vestibulo-ocular reflex, rotation tests in the weightless phase of parabolic flight, and the mechanisms of antimotion sickness drugs. I.S.

**A88-12952\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.****CLINICAL CHARACTERIZATION AND ETIOLOGY OF SPACE MOTION SICKNESS**

WILLIAM E. THORNTON, THOMAS P. MOORE, SAM L. POOL, and JAMES VANDERPLOEG (NASA, Johnson Space Center, Houston, TX; Methodist Hospital of Indiana, Indianapolis) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Sept. 1987, p. A1-A8. NASA-supported research. refs

An inflight, clinically-oriented investigation of space motion sickness (SMS) was begun on STS-4 and revealed the following: compared to motion sickness (MS) on earth, automatic signs are significantly different in SMS vs. MS in that sweating is not present, pallor or flushing may be present, and vomiting is episodic, sudden, and brief. Postflight there is a period of resistance to all forms of MS. There is some evidence for individual reduction in sensitivity on repeated flights. Electrooculogram, audio-evoked potentials, measurement of fluid shifts, and other studies are inconsistent with a transient vestibular hydrops or increased intracranial pressure as a cause. Author

**A88-12953\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**THE USE OF THE LOGISTIC MODEL IN SPACE MOTION SICKNESS PREDICTION**

KARL K. LIN and MILLARD F. RESCHKE (NASA, Johnson Space Center; Krug International, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A9-A15. refs  
(Contract NAS9-17200)

The one-equation and the two-equation logistic models were used to predict subjects' susceptibility to motion sickness in KC-135 parabolic flights using data from other ground-based motion sickness tests. The results show that the logistic models correctly predicted substantially more cases (an average of 13 percent) in the data subset used for model building. Overall, the logistic models ranged from 53 to 65 percent predictions of the three endpoint parameters, whereas the Bayes linear discriminant procedure ranged from 48 to 65 percent correct for the cross validation sample. Author

**A88-12954\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**GASTROINTESTINAL MOTILITY IN SPACE MOTION SICKNESS**

WILLIAM E. THORNTON, BARRY J. LINDER, THOMAS P. MOORE, and SAM L. POOL (NASA, Johnson Space Center, Houston, TX; Washington University, Saint Louis, MO; Methodist Hospital of Indiana, Indianapolis) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A16-A21. NASA-supported research. refs

Gastrointestinal symptoms in space motion sickness (SMS) are significantly different from those in ordinary motion sickness (MS). Recording and tabulation of sounds was the only technique that could be used as a measure of motility during spaceflight operations. There were 17 subjects, six unaffected by SMS, who made ambulatory recordings preflight and inflight. With one exception, all those affected had sharply reduced sounds, while those unaffected had increases or moderate reductions. The mechanism of vomiting in SMS appears to be secondary to this ileus, in contrast to vomiting in ordinary MS, where the emesis center is thought to be directly triggered by the vestibular system. Author

**A88-12956\*** Essex Corp., Orlando, Fla.

**TRANSFER OF PERCEPTUAL-MOTOR TRAINING AND THE SPACE ADAPTATION SYNDROME**

R. S. KENNEDY, K. S. BERBAUM, M. C. WILLIAMS, J. BRANNAN, and R. B. WELCH (Essex Corp., Orlando, FL; New Orleans, University, LA; Kansas, University, Lawrence) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A29-A33. refs  
(Contract NAS9-17278)

Perceptual cue conflict may be the basis for the symptoms which are experienced by space travelers in microgravity conditions. Recovery has been suggested to take place after perceptual modification or reinterpretation. To elucidate this process, 10 subjects who repeatedly experienced a visual/vestibular conflict over trials and days, were tested in a similar but not identical perceptual situation (pseudo-Coriolis) to determine whether any savings in perceptual adaptation had occurred as compared to an unpracticed control group ( $N = 40$ ). The practiced subjects experienced lessening dizziness and ataxia within and over sessions. Author

**A88-12957**

**A COMPARISON OF TWO METHODS OF TRAINING RESISTANCE TO VISUALLY-INDUCED MOTION SICKNESS**

THOMAS G. DOBIE, JAMES G. MAY, WANDA D. FISCHER, THOMAS S. ELDER, and KARLA A. KUBITZ (U.S. Navy, Naval Biodynamics Laboratory, New Orleans; New Orleans, University, LA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A34-A41. refs  
(Contract N00205-84-M-2632)

This report concerns the use of two methods of training subjects to tolerate visually-induced motion sickness. Sixteen subjects were selected on the basis of their response to a motion sickness history questionnaire and assigned to one of four groups on the basis of their ability to tolerate visually-induced motion (VM). One group received 10 sessions of confidence building and desensitization training (BT); a second group received 10 sessions of EMG and temperature biofeedback (FB); a third group received 10 sessions of BT and 10 sessions of FB (BTFB); and a fourth group received no treatment (C). The results indicated that the BT and BTFB groups exhibited significant increases in tolerance to VM when pretreatment measures were compared to posttreatment measures, while no significant increases in prepost measures were observed in the FB or C groups. Author

**A88-12959\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**RELIABILITY OF PROVOCATIVE TESTS OF MOTION SICKNESS SUSCEPTIBILITY**

D. S. CALKINS, M. F. RESCHKE, R. S. KENNEDY, and W. P. DUNLOP (NASA, Johnson Space Center, Houston, TX; Essex Corp., Orlando, FL; Tulane University, New Orleans, LA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A50-A54. refs

Test-retest reliability values were derived from motion sickness susceptibility scores obtained from two successive exposures to each of three tests: (1) Coriolis sickness sensitivity test; (2) staircase velocity movement test; and (3) parabolic flight static chair test. The reliability of the three tests ranged from 0.70 to 0.88. Normalizing values from predictors with skewed distributions improved the reliability. Author

**A88-12960**

**CENTRAL AND CORONARY CIRCULATION OF THE NORMAL MAN DURING ORTHOSTATIC AND LOWER BODY NEGATIVE PRESSURE TESTS**

V. E. KATKOV, V. V. CHESTUKHIN, L. I. KAKURIN, A. M. BABIN, and E. M. NIKOLAENKO (Institut Mediko-Biologicheskikh Problem; Nauchno-Issledovatel'skii Institut Transplantologii i Iskusstvennykh Organov, Moscow, USSR) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A55-A60. refs

The effects of the tilt test (60-70 deg for 20 min) and lower body negative pressure (LBNP) test (-30 and -60 mm Hg for 20 min each) on the basic parameters of circulation (15 subjects) and coronary circulation (11 subjects) were investigated. The study was performed using thermistor-equipped catheters implanted into the pulmonary artery and coronary sinus and Teflon catheters implanted into the brachial artery. The effect of the tilt test and LBNP test on the basic parameters of central and coronary circulation, blood acid-base equilibrium, and oxygenation was compared. Author

**A88-12961****HEART VOLUME DURING SHORT-TERM HEAD-DOWN TILT (-6 DEG) IN COMPARISON WITH HORIZONTAL BODY POSITION**

HANS KNITELIUS and JURGEN STEGEMANN (Deutsche Sporthochschule, Cologne, Federal Republic of Germany) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A61-A63. refs

The immediate effect of head-down tilt (5 min, -6 deg) on heart volume was investigated in nine healthy male volunteers. Heart volumes were determined by the X-ray method of Kahlstorf and Rohrer as modified by Musshoff and Reindell (1956). Biplane chest orthodiagrams were taken after 5 min of rest in a prone horizontal position (control values) and 5 min after tilting the examination table into a -6-deg head-down tilt position. After 5 min head-down tilt, cardiac volumes had increased significantly (+ 5.2 percent). The results indicate that head-down tilt leads to an immediate increase in heart volume. Author

**A88-12964\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**FLUID CONTROL MECHANISMS IN WEIGHTLESSNESS**

CAROLYN S. LEACH (NASA, Johnson Space Center, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A74-A79. refs

Experiments performed on Space Shuttle flights have emphasized study of the earliest effects of the cephalad fluid shift resulting from microgravity. Analysis of one subject's urine collected during flight showed that a sharp increase in antidiuretic hormone occurred within 2 h of launch, followed by an increase in cortisol excretion. Although this subject had symptoms of the space adaptation syndrome (SAS), inflight data from Spacelab missions suggested that these transient changes were not caused by SAS. Unpaired t-tests and Mann-Whitney tests showed that before and after flight, plasma thyroxine and urine osmolality were significantly higher in Shuttle crewmembers who exhibited more severe symptoms of SAS than in asymptomatic crewmembers. Author

**A88-12965****BODY VOLUME CHANGES DURING SIMULATED WEIGHTLESSNESS - AN OVERVIEW**

LESLIE D. MONTGOMERY (SRI International, Menlo Park, CA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A80-A85. refs

It has been hypothesized that many of the adaptive processes that occur in man during exposure to space involve the rapid headward shift of tissue fluids, blood, and other fluids during the first few hours of space flight. A total of 53 men and women between the ages of 22 and 55 years were tested during four bed-rest studies lasting between 4 h and 7 d to define the segmental volume changes that took place during simulated weightlessness. Impedance plethysmography can be used to measure baseline resistance (R0) changes of the calf, thigh, total leg, pelvic, torso, and arm segments before, during, and after each bed-rest exposure. Records of R0 were analyzed to determine the fluid volume and volume change of each segment during each test sequence. Author

**A88-12966\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**FLUID SHIFTS IN WEIGHTLESSNESS**

WILLIAM E. THORNTON, THOMAS P. MOORE, and SAM L. POOL (NASA, Johnson Space Center, Houston, TX; Methodist Hospital of Indiana, Indianapolis) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A86-A90. refs

Studies of leg volumes in space by multiple girth measurements showed reductions of 1.9 l (12.8 percent of leg volume), with 1.1 l from the nondominant leg, on Skylab 4. On landing, 65 percent of postflight leg volume increase was complete at 1.5 h. Measurement of the dominant leg during the equivalent period on Shuttle showed a mean loss of 0.9 l which was 90-percent complete at 150 min. Postflight increases were 87-percent complete at 1.5 h postlanding. Mass measurements during and after Skylab 4 showed a loss of 2.5 kg over the first 4 d on orbit, with a gain of 2.7 kg over the first 4 d of recovery. These changes are assumed to be tissue fluids secondary to changes in hydrostatic pressures and are much greater than those seen in bed rest. Rate and magnitude of inflight and postflight changes have significant operational impact. Author

**A88-12967\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**SPACE SHUTTLE INFLIGHT AND POSTFLIGHT FLUID SHIFTS MEASURED BY LEG VOLUME CHANGES**

THOMAS P. MOORE and WILLIAM E. THORNTON (Methodist Hospital of Indiana, Indianapolis; NASA, Johnson Space Center, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A91-A96.

This is a study of the inflight and postflight leg volume changes associated with spaceflight on Space Shuttle missions. The results show an inflight volume loss of 2 l from the lower extremities, 1 l from each leg, representing an 11.6 percent volume change. The vast majority of this change appears to be a shift in body fluids, both intravascular and extravascular. The fluid shift occurs mostly on Mission Day One and is essentially complete by 6 to 10 hr. The regional origin of shift and leg volume changes shows a far greater absolute volume (708 ml vs. 318 ml) and percentage (69 percent vs. 31 percent) of the total change coming from the higher as compared to the lower leg. Postflight, the return of fluid to the lower extremities occurs rapidly with the majority of volume return complete within 1.5 hr postlanding. At 1 week postflight, there is a residual leg volume decrement of 283 ml or 3.2 percent that is probably due to tissue loss secondary to atrophic deconditioning and weight loss. Author

**A88-12968****THE EFFECTS OF EXERCISE ON BUBBLE FORMATION AND BENDS SUSCEPTIBILITY AT 9,100 M (30,000 FT; 4.3 PSIA)**

ROBERT W. KRUTZ and GENE A. DIXON (Technology, Inc., Life Sciences Div., San Antonio, TX; USAF, School of Aerospace Medicine, Brooks AFB, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A97-A99.

This study assessed the value of controlled exercise in a bends susceptibility test. Healthy male subjects were exposed to a pressure altitude of 9100 m for a period not exceeding 8 h on two separate days at least one week apart. During one exposure, subjects performed five deep knee bends followed by five upward arm extensions with 5-lb weights every 15 min; during the other exposure, they remained sedentary. Exercise and no-exercise altitude exposures were randomized between subjects. A precordial Doppler monitoring technique was used to record venous bubbling at 15-min intervals. Bends was diagnosed from subjective



symptoms. Results show that controlled exercise decreases time to maximum venous bubbling and increases the incidence of Grade 2 bends compared to no-exercise conditions. Exercise also appears to increase the validity of precordial Doppler monitoring as a method to predict bends onset. Author

**A88-12969\*** Duke Univ., Durham, N. C.

### EFFECTS OF MICROGRAVITY ON TISSUE PERFUSION AND THE EFFICACY OF ASTRONAUT DENITROGENATION FOR EVA

WAYNE A. GERTH, RICHARD D. VANN, NELSON E. LEATHERMAN, and MICHAEL D. FEEZOR (Duke University, Durham, NC) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A100-A105. refs (Contract NAS9-17160)

A potentially flight-applicable, breath-by-breath method for measuring N<sub>2</sub> elimination from human subjects breathing 100 percent O<sub>2</sub> for 2-3 hr periods has been developed. The present report describes this development with particular emphasis on required methodological accuracy and its achievement in view of certain properties of mass spectrometer performance. A method for the breath-by-breath analysis of errors in measured N<sub>2</sub> elimination profiles is also described. Author

**A88-12970**

### A LIKELIHOOD ANALYSIS OF EXPERIMENTS TO TEST ALTITUDE DECOMPRESSION PROTOCOLS FOR SHUTTLE OPERATIONS

RICHARD D. VANN, WAYNE A. GERTH, NELSON E. LEATHERMAN, and MICHAEL D. FEEZOR (Duke University, Durham, NC) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A106-A109. (Contract PHS-RR-01693)

Maximum likelihood was applied to 548 individual altitude exposures from 30 experimental pressure profiles tested by NASA and the Air Force. Twelve decompression models were studied, including modified Haldane models and models which assume that stationary bubbles cause Type I decompression sickness. The data were best represented by a model in which a bubble in tissue is surrounded by a diffusion barrier, but this representation was statistically indistinguishable from a single tissue Haldane model with a half-time of 508 min. By providing a quantitative measure of the agreement between theory and data, the principle of maximum likelihood offers an opportunity for improving the understanding of decompression mechanisms and for developing safer and faster decompression procedures. Author

**A88-12971\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### THE EFFECT OF EXTENDED O<sub>2</sub> PREBREATHING ON ALTITUDE DECOMPRESSION SICKNESS AND VENOUS GAS BUBBLES

JAMES M. WALIGORA, DAVID J. HARRIGAN, and JOHNNY CONKIN (NASA, Johnson Space Center, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A110-A112. refs

The purpose of this study was to determine the effect of extended O<sub>2</sub> prebreathing on symptom and bubble incidence during decompressions simulating extravehicular activity. The 38 subjects breathed O<sub>2</sub> for a 6-hr period prior to decompression to 4.3 psi. The subjects performed upper body exercises for 6 hr. Eight subjects were exposed to the same protocol after an 8-hr prebreathe. Venous bubbles were detected in 18 of 38 subjects decompressed after the 6-hr prebreathe. Four of these subjects

reported symptoms of altitude decompression sickness. No symptoms or bubbles were detected in the eight subjects who had prebreathed 8 hr. The incidence of symptoms and bubbles, when combined with prior data on 3.5- and 4.0-hr prebreathes, showed an inverse correlation to prebreathing time. The incidence of symptoms was higher than has been reported for subjects exposed to decompression of shorter duration with less activity. Author

**A88-12972**

### PROBABILITY OF OXYGEN TOXICITY USING AN 8 PSI SPACE SUIT

PAUL A. FURR (Grumman Corp., Space Systems Div., Bethpage, NY) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A113-A120. refs

Oxygen toxicity has been studied extensively, and a review of the literature suggests that continuous exposure to a PO<sub>2</sub> of 8 psi can be tolerated indefinitely and should not present the astronaut with a problem for the EVA scenarios projected for Space Station. However, the cause of the decrease in circulating red blood cell mass, which has been shown to accompany exposure to microgravity as well as hyperoxemia, is not as well defined when both conditions are simultaneously present. Author

**A88-12973**

### METABOLIC AND HORMONAL STATUS OF CREWMEMBERS IN SHORT-TERM SPACEFLIGHTS

A. I. GRIGOR'EV, I. A. POPOVA, and A. S. USHAKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A121-A125. refs

In order to clarify biochemical adaptation of the human body to short-term microgravity, metabolic and hormonal parameters were investigated in 20 cosmonauts who performed orbital flights of 4 to 14 d in duration. The specific feature of adaptation to this exposure is the transition to a new level of hormonal regulation with a significant increase of the content (production) of glucocorticoids, catecholamines, components of the renin-angiotension-aldosterone system (which determines a modified activity of tissue hormones), and fluid-electrolyte homeostasis, as well as simultaneous increase of insulin secretion (which diminishes the metabolic effects of glucocorticoids and catecholamines). Author

**A88-12974\*** Rockefeller Univ., New York.

### POSSIBLE ROLE OF BRAIN STEM RESPIRATORY NEURONS IN MEDIATING VOMITING DURING SPACE MOTION SICKNESS

A. D. MILLER and L. K. TAN (Rockefeller University, New York) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A126-A128. refs (Contract NAG2-164; NSG-2380; NIH-NS-20585; NIH-NS-02619; NIH-RR-07065; NSF BNS-83-17651)

The object of this study was to determine if brain stem expiratory neurons control abdominal muscle activity during vomiting. The activity of 27 ventral respiratory group expiratory neurons, which are known to be of primary importance for control of abdominal muscle activity during respiration, was recorded. It is concluded that abdominal muscle activity during vomiting must be controlled not only by some brain stem expiratory neurons but also by other input(s). Author



**A88-12975****MEASURES OF AUDITORY EVOKED POTENTIALS DURING OPTOKINETIC STIMULATION**

JOHN K. CULLEN, JR., RANDAL D. RAMPP, JAMES G. MAY, and THOMAS G. DOBIE (Louisiana State University, New Orleans, University; U.S. Navy, Naval Biodynamics Laboratory, New Orleans, LA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A129-A132. refs  
(Contract N00205-84-M-2632)

Auditory brainstem responses elicited by click stimuli were recorded before, during, and after optokinetic stimulation in subjects that were ( $N = 10$ ) or were not ( $N = 10$ ) prone to visually induced motion sickness. The latency of Wave I, and the I-III and I-IV interwave intervals were measured. Results suggest that optokinetic stimulation may alter neural activity in the region of the superior olivary complex, a structure known to be important in sound-source localization. Author

**A88-12977****SIMULATION OF SPACEFLIGHT WITH WHOLE-BODY HEAD-DOWN TILT - INFLUENCE ON INTRAOCULAR PRESSURE AND RETINOCORTICAL PROCESSING**

BARRY J. LINDER and GARY L. TRICK (Washington University, Saint Louis, MO) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A139-A142. refs

Cephalad fluid shifts occur in the microgravity environment of space flight. Whole-body head-down tilt was used to simulate the influence of these fluid shifts upon intraocular pressure (IOP) and the bioelectrical activity of neural elements in the retinocortical pathway. Noninvasive techniques were used to monitor IOP, pattern reversal electroretinograms, and pattern reversal visual evoked cortical potentials when subjects were oriented either upright or in a head-down position (6 or 90 deg). The results indicate that there is a significant elevation in IOP when an individual is oriented in a head-down position. Significant alterations of neurophysiological processing in the retinocortical pathway also occur when individuals are oriented in a head-down position. Author

**A88-12979****THE NATURE OF SENSORIMOTOR ADAPTATION TO ALTERED G-LEVELS - EVIDENCE FROM MASS DISCRIMINATION**

HELEN E. ROSS (Stirling, University, Scotland), EDWIN SCHWARTZ (DFVLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), and PAUL EMMERSON (Aston, University, Birmingham, England) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A148-A152. Research supported by the Medical Research Council, University of Stirling, and BMFT. refs

Mass discrimination is impaired under zero G compared to 1 G. This is partly due to loss of weight information (a reduction in z-axis pressure stimulation), and probably also to incomplete adaptation to the reduced G-level. Maladaptation to an increased G-level postflight causes objects to feel too heavy and weight discrimination to be impaired. Video tapes of hand movements while shaking test objects were made before, during, and after the D-1 Spacelab mission. Movements were faster inflight than preflight, slowed down postflight and returned to baseline by about the third day. Corresponding changes in movement amplitude also occurred. Errors of weight or mass perception during the maladaptation phase may be due to both inadequate monitoring of command signals and to inappropriate scaling of afferent signals. High-acceleration shaking was found to improve mass discrimination but impair weight discrimination. Author

**A88-12980\***

National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Texas. **EFFECTS OF PROLONGED WEIGHTLESSNESS ON SELF-MOTION PERCEPTION AND EYE MOVEMENTS EVOKED BY ROLL AND PITCH**

MILLARD F. RESCHKE and DONALD E. PARKER (NASA, Johnson Space Center, Houston, TX; Miami University, Oxford, OH) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A153-A158. refs  
(Contract NAS9-17413; NAS9-17267)

Seven astronauts reported translational self-motion during roll simulation 1-3 h after landing following 5-7 d of orbital flight. Two reported strong translational self-motion perception when they performed pitch head motions during entry and while the orbiter was stationary on the runway. One of two astronauts from whom adequate data were collected exhibited a 132-deg shift in the phase angle between roll stimulation and horizontal eye position 2 h after landing. Neither of two from whom adequate data were collected exhibited increased horizontal eye movement amplitude or disturbance of voluntary pitch or roll body motion immediately postflight. These results are generally consistent with an otolith tilt-translation reinterpretation model and are being applied to the development of apparatus and procedures intended to preadapt astronauts to the sensory rearrangement of weightlessness. Author

**A88-12983\*** McGill Univ., Montreal (Quebec).

**THE VESTIBULO-OCULAR REFLEX AND ITS POSSIBLE ROLES IN SPACE MOTION SICKNESS**

DOUGLAS G. D. WATT (McGill University, Montreal, Canada) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A170-A174. Research supported by the Medical Research Council of Canada, DND, and NASA. refs

Prolonged exposure to an inappropriate vestibulo-ocular reflex (VOR) will usually lead to motion sickness, and it has been predicted on theoretical grounds that VOR gain may be decreased in weightlessness. While experiments during parabolic flight in aircraft tend to confirm this prediction, experiments during orbital spaceflight have led to apparently contradictory results. It is suggested that VOR gain is reduced initially, but that rapid compensatory mechanisms restore it to normal within minutes of reaching weightlessness. However, even though this process may lead to the rapid return of functionally normal gaze stability, it may not protect against the development of motion sickness. Author

**A88-12984****VESTIBULO-OCULAR REFLEX DURING MAGNIFIED VISION - ADAPTATION TO REDUCE VISUAL-VESTIBULAR CONFLICT**

JOSEPH L. DEMER, JEFIM GOLDBERG, HERMAN A. JENKINS, and FRANKLIN I. PORTER (Cullen Eye Institute; Clayton Foundation for Research; Baylor University, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A175-A179. Research supported by the Clayton Foundation for Research. refs  
(Contract NIH-EY-06394-01)

This report describes the short-term effect of 2.2X telescopic spectacles on the vestibuloocular reflex (VOR) in seven volunteers. VOR gain was initially measured in darkness and light during passive sinusoidal rotations. Subjects were then rotated in light for 15 min while wearing telescopic spectacles. Dynamic visual acuity (DVA), vision during head rotation, was measured with telescopic spectacles. Initial VOR gain in darkness was  $0.74 \pm$  or  $-0.1$ ; VOR gain with unmagnified vision was  $1.07 \pm$  or  $-0.04$ .

Initial VOR gain with magnified vision was  $1.37 \pm 0.53$ . DVA was poorer than static acuity in three of four subjects. After adaptation, VOR gain in darkness increased to  $0.83 \pm 0.12$ , with six of seven subjects exhibiting a gain increase of 7-23 percent. Adapted VOR gain with magnified vision was  $1.54 \pm 0.25$ . Adapted performance was more consistent, and oscillopsia was reduced. Adapted DVA improved 30-100 percent in four subjects. These changes indicate VOR adaptation to telescopic spectacles decreases visual-vestibular conflict. Author

**A88-12985\*** Good Samaritan Hospital and Medical Center, Portland, Oreg.  
**OPTOKINETIC AND VESTIBULO-OCULAR REFLEX RESPONSES TO AN UNPREDICTABLE STIMULUS**  
 ROBERT J. PETERKA, F. OWEN BLACK, and MONIKA B. SCHOENHOFF (Good Samaritan Hospital and Medical Center, Portland, OR) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A180-A185. refs (Contract NCC9-8)

Horizontal plane optokinetic (OKR) and vestibuloocular reflex eye movements were obtained from normal subjects in response to pseudorandom rotational stimulation. Results showed large intersubject variability in OKR responses. Typical OKR responses had approximately constant gain over 0.02-1.5 Hz. Response phase was near zero below 0.1 Hz with increasing phase lags as frequency increased consistent with time delays of 180 ms. Results suggested that visual motion information could be significant in the control of eye movements up to 6.1 Hz. Pseudorandom optokinetic stimulation induced motion sickness symptoms in approximately 20 percent of the 213 subjects tested. Author

**A88-12989**  
**EFFECTS OF A VISUAL-VESTIBULAR STIMULUS ON THE VESTIBULO-OCULAR REFLEX**

DANIEL WOODARD, DONALD PARKER, and HENNING VON GIERKE (Wright State University, Dayton; USAF, Wright-Patterson AFB; Miami University, Oxford, OH) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A198-A202. refs

Exposure before flight to an environment that provides altered visual-vestibular relationships similar to those seen in weightlessness might facilitate adaptation to spaceflight. Fifteen normal subjects were exposed for 0, 5, and 20 min to an abnormal visual-vestibular environment in which the vestibular sensation of lateral tilt was associated with the visual impression of lateral translation. Lateral eye movement elicited by similar tilt in darkness was measured before and at intervals after the exposure. Of the 15 subjects, 12 showed increased VOR amplitude following the exposure, but this increase appeared unrelated to the duration of exposure to the visual stimulus and may be an effect of the VOR measurement procedure. Most subjects showed little shift in the phase relationship between tilt and eye motion. Three subjects showed changes in VOR and five reported changes in perception of motion which appear clearly related to the visual-vestibular exposure. Author

**A88-12990**  
**VESTIBULAR RESPONSE TO PSEUDORANDOM ANGULAR VELOCITY INPUT - PROGRESS REPORT**

CHARLES S. LESSARD and WING CHAN WONG (Texas A & M University, College Station) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A203-A206. refs

Space motion sickness was not reported during the first Apollo missions; however, since Apollo 8 through the current Shuttle and

Skylab missions, approximately 50 percent of the crewmembers have experienced instances of space motion sickness. One of NASA's efforts to resolve the space adaptation syndrome is to model the vestibular response for both basic knowledge and as a possible predictor of an individual's susceptibility to the disorder. This report describes a method to analyze the vestibular system when subjected to a pseudorandom angular velocity input.

Author

**A88-12992\*** Brandeis Univ., Waltham, Mass.  
**HEAD MOVEMENTS IN LOW AND HIGH GRAVITOINERTIAL FORCE ENVIRONMENTS ELICIT MOTION SICKNESS - IMPLICATIONS FOR SPACE MOTION SICKNESS**

JAMES R. LACKNER and ASHTON GRAYBIEL (Brandeis University, Waltham, MA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A212-A217. refs (Contract NAS9-15147)

Astronauts report that head movements in flight tend to bring on symptoms of space motion sickness (SMS). The effects of head movements in pitch, yaw, and roll (made both with normal vision and with eyes occluded) on susceptibility to motion sickness in the zero G phase of parabolic flight maneuvers were evaluated. The findings are clear-cut: pitch head movements are most provocative, yaw least provocative, and roll intermediate. These experiments suggest that SMS is not a unique nosological entity, but is the consequence of exposure to nonterrestrial force levels. Head movements during departures in either direction from 1 G elicit symptoms. Author

**A88-12993\*** Brandeis Univ., Waltham, Mass.  
**THE INFLUENCE OF GRAVITOINERTIAL FORCE LEVEL ON OCULOMOTOR AND PERCEPTUAL RESPONSES TO CORIOLIS, CROSS-COUPLING STIMULATION**

PAUL DIZIO, JAMES R. LACKNER, and JOHN N. EVANOFF (Brandeis University, Waltham, MA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A218-A223. refs

(Contract NAS9-15147)

The goal of the present experiment was to determine whether gravitoinertial force magnitude influences oculomotor and perceptual responses to Coriolis cross-coupling stimulation. Blindfolded subjects who were rotating at constant velocity were asked to make standardized head movements during the free-fall and high-force phases of parabolic flight, and the characteristics of their horizontal nystagmus and the magnitude of their experienced self-motion were measured. Both responses were less intense in the free-fall periods than in the high-force periods. These findings suggest that the response to semicircular canal stimulation depends on the background level of gravitoinertial force. R.R.

**A88-12994\*** Brandeis Univ., Waltham, Mass.  
**THE INFLUENCE OF GRAVITOINERTIAL FORCE LEVEL ON OCULOMOTOR AND PERCEPTUAL RESPONSES TO SUDDEN STOP STIMULATION**

PAUL DIZIO, JAMES R. LACKNER, and JOHN N. EVANOFF (Brandeis University, Waltham, MA) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A224-A230. refs

(Contract NAS9-15147)

The goal of this investigation was to determine whether the vestibular response to vertical, z-axis body rotation in the dark is influenced by the magnitude of gravitoinertial force. The parameters measured were the nystagmus and the duration of illusory self-motion elicited in blindfolded subjects by cessation of such

rotation during the free-fall, high, and terrestrial force phases of parabolic flight maneuvers. The pattern of findings is consistent with the responses that were observed earlier to constant levels of Coriolis cross-coupled stimulation during parabolic flight maneuvers both in terms of the mode of nystagmus suppression and the effect of G-level. Author

#### A88-12995

##### A NEW AND SIMPLE CALIBRATION OF THE ELECTRO-OCULAR SIGNALS FOR VESTIBULO-OCULAR MEASUREMENTS

ARNE MANSSON and SOREN VESTERHAUGE (Rigshospitalet, Copenhagen, Denmark) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A231-A235.

Reliable calculation of the gain of the vestibuloocular reflex depends on a reliable way of calibrating the eye movements. During the new calibration maneuver, the subject fixes the eyes at a point about 1 m away and moves the head either in pitch or yaw approximately + or - 30 deg. The head movements are recorded by means of an angular rate sensor. The eye movements are recorded with standard surface electrodes. By integrating the angular rate signal, the precise head position angle is calculated. The fixating eyes will compensate for this angle, and thus the signal level of the eye movements is defined. Author

#### A88-13002\* Louisiana State Univ., Shreveport.

##### MECHANISMS OF ANTIMOTION SICKNESS DRUGS

C. D. WOOD, J. E. MANNO, M. J. WOOD, B. R. MANNO, and H. M. REDETZKI (Louisiana State University, Shreveport) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A262-A265. refs  
(Contract NAS9-16801)

Eight subjects, male and female, were rotated using the step method to progressively increase the speed of rotation (+2 rpm) after every 40 head movements to a maximum of 35 rpm. The end point for motion sickness was the Graybiel Malaise III total of symptoms short of frank nausea. The drug treatments were placebo, scopolamine 0.6 mg and 1 mg, scopolamine 0.6 mg/d-amphetamine 10 mg, scopolamine 1 mg/d-amphetamine 10 mg, and amphetamine 10 mg. Scopolamine increased tolerated head movements over placebo level by + 81; scopolamine 1 mg + 183; d-amphetamine by + 118; scopolamine 0.6/d-amphetamine by + 165; and scopolamine 1 mg/d-amphetamine 10 mg by + 201. The drugs effective in preventing motion sickness are considered to be divided into those with central acetylcholine blocking activity and those which enhance norepinephrine activity. A combination of both of these actions produces the most effective antimotion sickness medications. It is concluded that the balance between the acetylcholine and norepinephrine activity in the CNS appears to be responsible for motion sickness. Author

#### A88-13003\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

##### HORMONAL RESPONSES OF METOCLOPRAMIDE-TREATED SUBJECTS EXPERIENCING NAUSEA OR EMESIS DURING PARABOLIC FLIGHT

RANDALL L. KOHL (NASA, Johnson Space Center; Universities Space Research Association, Houston, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A266-A269. refs

The concentrations of adrenocorticotrophic hormone (ACTH), vasopressin (AVP), epinephrine (EPI), and norepinephrine (NE) in 22 subjects administered 10 to 20 mg of metoclopramide prior to parabolic flight are measured. The effect of metoclopramide on

motion sickness is examined. It is observed that metoclopramide is ineffective in the modulation of motion sickness due to stressful linear and angular acceleration and orbital flight, and it does not affect serum hormones prior to parabolic flight. It is detected that the serum level of AVP declines following emesis induced by parabolic flight and stressful angular acceleration; the serum levels of ACTH and EPI are elevated by parabolic flight and stressful angular acceleration; and serum NE is significantly elevated immediately following emesis. The possible roles of these hormones in the etiology of space motion sickness are discussed. I.F.

#### A88-13004

##### PHARMACOLOGICAL INTERVENTIONS FOR MOTION SICKNESS - CARDIOVASCULAR EFFECTS

F. A. SUNAHARA, J. FAREWELL, L. MINTZ, and W. H. JOHNSON (Toronto, University, Canada) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A270-A276. refs

Motion sickness (MS) was provoked in healthy volunteers subjected to simultaneous rotation through the vertical axis with head movements (HM). Arterial blood pressure (BP), heart rate (HR) and forearm blood flows (BF) were intermittently monitored. Forearm BF was measured by venous occluding plethysmography. Rotation at 20 rpm and cyclic HM were continued for 10 min or until the subject requested cessation of HM because of imminent emesis. There were no consistent changes in BP or HR, but marked increases in BF were observed with MS. There was an inverse correlation between duration of HM tolerance and increments in BF. Antimotion sickness medications scopolamine:d-amphetamine (0.4:5.0 mg) or promethazine:ephedrine (25:60 mg) failed to significantly increase the duration of HM; the latter mixture, however, did significantly reduce the HM-induced-hyperemic responses. Administration of naproxyn (275 or 550 mg) did not significantly alter HM duration or BF responses. These studies suggest that BF changes may be an objective index of MS susceptibility. Author

#### N88-10478# Institute for Perception RVO-TNO, Soesterberg (Netherlands). Thermal Physiology Group.

##### DETERMINATION OF THE INDIVIDUAL STATE OF ACCLIMATIZATION

G. HAVENITH and H. VANMIDDENDORP Oct. 1986 23 p (IZF-1986-27; TD-86-4548; ETN-87-90858) Avail: NTIS HC A03/MF A01

A subject's state of acclimatization was defined in terms of sweat rate, core temperature, and heart rate to a heat stress test. The overall effect of acclimatization is similar to results in the literature; lower heart rate, higher sweat sensitivity, lower core temperature. Individual effects, however, are more difficult to interpret. Qualitatively, they all show the mentioned changes, but comparing their individual physiological reactions, differences are observed. Ranking orders for their acclimatization state, based on heart rate response, are different from those based on core temperature and sweat rate-core temperature relation responses. It appears that the heart rate, core temperature and sweat rate-core temperature relations are correlated to the acclimatization state, whereas the heart-rate response is also strongly influenced by fitness level. ESA

#### N88-10479# Oak Ridge National Lab., Tenn.

##### RADIATION EFFECTS IN SPACE

R. J. M. FRY Jul. 1987 6 p Presented at the 8th International Congress of Radiation Research, Edinburgh, Scotland, 19 Jul. 1987

(Contract DE-AC05-84OR-21400)

(DE87-012529; CONF-870701-3) Avail: NTIS HC A02/MF A01

As more people spend more time in space, and the return to the Moon and exploratory missions are considered, the risks require continuing examination. The effects of microgravity and radiation are two potential risks in space. These risks increase with increasing

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mission duration. This document considers the risk of radiation effects in space workers and explorers. DOE

**N88-10480#** California Univ., Berkeley. Lawrence Berkeley Lab.

**LOCAL HUMAN SKIN POTENTIAL: SPATIAL DISTRIBUTION, MAGNITUDE AND ORIGIN Ph.D. Thesis**

C. CULLANDER Apr. 1987 174 p

(Contract DE-AC03-76SF-00098)

(DE87-012882; LBL-23450) Avail: NTIS HC A08/MF A01

The sources and distribution of the slowly varying electric potential across hairy skin and the spatial distribution of the eccrine gland pores, which may be related to the skin potential, are investigated. The transdermal electrical potential in the same area on the back of the hands of eight subjects was measured under experimental conditions designed to minimize eccrine gland activity. The mean potential over all subjects was 24.86 +/- 8.16 mV. The pore distribution was evaluated by transferring the imprint of pilocarpine-stimulated gland secretions on special paper to digitized arrays. The average gland count over all records for the mean electrode radius (1 mm) was 9.09 +/- 3.55 glands. The correlation between the measured potential and the number of glands at each measurement site was calculated, and in general, the measured potential was independent of gland count. This lack of correlation was consistent with an equivalent circuit model for non-sudorific potential generation. This model predicted a minimal contribution from the passive glands and the existence of at least one other source of potential. One such source is regional variability in the permeability barrier of the skin. The pore arrays were also used to make a spectral analysis of the spatial frequencies present in the point pattern. Radial profiles of the power spectra and autocorrelation estimates demonstrated that the inter-pore distance is nearly constant (0.49 +/- 0.043 mm). The larger scale periodicity of 1.84 +/- 0.35 mm is related to the absence of glands surrounding hair follicles. Simulations of gland distributions by a stochastic model were used to verify the uniqueness of the findings. DOE

**N88-10481#** Stockholm Univ. (Sweden). Inst. of Physics.

**FAST DYNAMIC STUDIES WITH PC384-7B; SYSTEM IMPROVEMENTS AND DEVELOPMENT OF AN AUTOMATED BLOOD SAMPLING SYSTEM**

L. ERIKSSON, M. MOSSKIN, CHR. BOHM, M. KESSELBERG, B. HOVANDER, and S. HOLTE Apr. 1987 23 p

(USIP-87-05; ETN-87-90749) Avail: NTIS HC A03/MF A01

An improvement in a positron emission tomography camera system, reducing the dead time, was implemented. An automated blood sampling system was constructed and evaluated. Two different detector units in the blood sampling system are compared. Results from regional cerebral blood flow studies are discussed.

ESA

**N88-10482#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

**DETECTION OF HYPERVENTILATION OF PARACHUTISTS Ph.D. Thesis - Technische Univ., Hanover, West Germany**

HANS-DIETRICH MELZIG Feb. 1987 125 p In GERMAN; ENGLISH summary

(DFVLR-FB-87-11; ISSN-0171-1342; ETN-87-90458) Avail:

NTIS HC A06/MF A01; DFVLR, Cologne, West Germany DM 42.50

The experimental verification of parachutist hyperventilation and its possible effect on the nonopening of the parachute were investigated. The breathing gas contents and volumes of 100 parachutists were measured. Significant reductions of assimilated oxygen and carbon dioxide are recorded. Thus, a possible hypocapnia (reduced blood carbon dioxide) is demonstrated, especially during the critical jump phase (jump-freefall-canopy opening). As a consequence, the effect of hyperventilation has to be taken into account in parachutist accidents. Preventive measures during the medical examination have to be established, including a briefing. ESA

**N88-10483\*#** Texas Univ., Houston. Health Science Center.

**PREVENTION OF DISUSE OSTEOPOROSIS: EFFECT OF SODIUM FLUORIDE DURING FIVE WEEKS OF BED REST Final Report**

VICTOR S. SCHNEIDER Oct. 1987 64 p

(Contract NAS9-16688)

(NASA-CR-172018; NAS 1.26:172018) Avail: NTIS HC A04/MF A01 CSCL 06E

An attempt was made to modify factors which promote disuse osteoporosis and thereby prevent it from occurring. Since fluoride is currently used to enhance bone formation in the treatment of low turnover osteoporosis, it was hypothesized that if the fluoride ion was available over a long period of time that it would slow the demonstrated loss of calcium by inhibiting bone resorption and enhancing bone formation. This study was used to determine whether oral medication with sodium F will modify or prevent 5 weeks of bed rest induced disuse osteoporosis, to determine the longitudinal effects of 5 weeks of bed rest on PTH, CT and calcitriol, to measure muscle volume changes and metabolic activity by magnetic resonance imaging and magnetic resonance spectroscopy during prolonged bed rest, to measure changes in peak muscle strength and fatigability, and to measure bone turnover in bone biopsies. Subjects were studied during 1 week of equilibration, 4 weeks of control ambulation, 5 weeks of bed rest, and 1 week of reambulation. E.R.

**N88-11366#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

**SLEEP AND WAKEFULNESS: HANDBOOK FOR FLIGHT MEDICAL OFFICERS, SECOND EDITION**

A. N. NICHOLSON and BARBARA M. STONE (Royal Air Force Inst. of Aviation Medicine, Farnborough, England) Jul. 1987 75 p

(AGARD-AG-270(E)) Avail: NTIS HC A04/MF A01

The first edition of this handbook was published in 1982, and since then the understanding of sleep and wakefulness has advanced considerably. This new handbook emphasizes the management of aircrew and the problems they experience in coping with irregularity of rest and activity. Author

**N88-11367\*** National Aeronautics and Space Administration, Washington, D.C.

**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES**

Nov. 1987 70 p

(NASA-SP-7011(303); NAS 1.21:7011(303)) Avail: NTIS HC A05 CSCL 06E

This bibliography lists 187 reports, articles, and other documents introduced into the NASA scientific and technical information system in October, 1987. Author

**N88-11368#** Institut National des Sciences Appliquees de Lyon, Villeurbanne (France).

**STUDY OF THE DISTRIBUTION OF A MULTI-ELECTRODE CIRCULAR SYSTEM SENSITIVITY FOR THE RECONSTRUCTION OF BIOELECTRICAL IMPEDANCE IMAGES Ph.D. Thesis**

[ETUDE DE LA DISTRIBUTION DE LA SENSIBILITE D'UN SYSTEME CIRCULAIRE MULTI-ELECTRODES EN VUE DE LA RECONSTRUCTION D'IMAGES D'IMPEDANCE BIO-ELECTRIQUE] GEORGES KARDOUS 1987 156 p In FRENCH

(ISAL-ID11-87-01; ETN-87-90898) Avail: NTIS HC A08/MF A01

The theoretical aspects of impedance technique imagery are reviewed and the experimental set-up for the in-vitro study of sensitivity distribution is described. The results are condensed in sensitivity records including the plane and volume sensitivity measurements in an eight electrode circular system. The analysis of applications includes the study of the inverse problem, that is the internal or cross section image reconstruction from a set of known injected currents and surface potential measurements. Examples of small matrix inversions are presented. ESA

## BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**A88-10153****DEVELOPMENT OF THREE-DIMENSIONAL AUDIO SIGNALS**

THEODORE J. DOLL (Georgia Institute of Technology, Atlanta) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 21-31. USAF-supported research. refs (SAE PAPER 861660)

It is shown that the acoustic cues necessary for auditory localization can be simulated and presented via headphones with sufficient fidelity to achieve localization performance comparable to that with the unaided ear. Potential benefits and issues associated with cockpit applications of three-dimensional audio are discussed and a facility for synthesizing three-dimensional audio cues and presenting the same to human listeners is described. Experiments were conducted which reveal that, as long as the listener's head is free to move, localization performance with simulated cues should not be seriously degraded for nonoptimal audio signals such as aircraft warning tones and speech. K.K.

**A88-10161****THE IMPACT OF NEW TECHNOLOGY ON PILOT WORKLOAD**

A. H. ROSCOE and B. S. GRIEVE (Britannia Airways, Ltd., Luton, England) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 91-98. refs (SAE PAPER 861773)

This paper describes a limited scientific study to compare the levels of workload experienced by pilots flying the Boeing 767 and 737 aircraft. The in-flight assessment technique involves recording the pilot's heart rate to augment his subjective impressions of workload using a ten-point rating scale. To date, data from three pilots tend to support the prediction that levels of workload on the 767 are lower than on the 737. Author

**A88-10165\*** Sterling Software, Moffett Field, Calif.**EVALUATING THE SUBJECTIVE WORKLOAD OF DIRECTIONAL ORIENTATION TASKS WITH VARYING DISPLAY FORMATS**

RONALD C. MILLER (Sterling Software, Palo Alto, CA), MICHAEL R. BORTOLUSSI (BITS, Inc., Moffett Field, CA), and SANDRA G. HART (NASA, Ames Research Center, Moffett Field, CA) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 135-138. refs (SAE PAPER 861640)

The impact of various flight-related tasks on the workload imposed by the requirement to compute new headings, course changes, and reciprocal headings is investigated experimentally. It is shown that, in terms of speed and accuracy, pilots are more efficient when alphanumeric display formats are provided. It is suggested that a voice command of 'turn to a specific heading' would provide the optimal method for issuing heading changes when used in conjunction with an alphanumeric display format. K.K.

**A88-10166\*** Illinois Univ., Urbana.**ASSESSMENT OF PILOT WORKLOAD - CONVERGING MEASURES FROM PERFORMANCE BASED, SUBJECTIVE AND PSYCHOPHYSIOLOGICAL TECHNIQUES**

ARTHUR F. KRAMER, ERIK J. SIREVAAG, and ROLF BRAUNE (Illinois, University, Urbana) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 139-146. NASA-supported research. refs (SAE PAPER 861641)

This study explores the relationship between the P300 component of the event-related brain potential (ERP) and the processing demands of a complex real-world task. Seven male volunteers enrolled in an Instrument Flight Rule (IFR) aviation course flew a series of missions in a single engine fixed-based simulator. In dual task conditions subjects were also required to discriminate between two tones differing in frequency. ERPs time-locked to the tones, subjective effort ratings and overt performance measures were collected during two 45 min flights differing in difficulty (manipulated by varying both atmospheric conditions and instrument reliability). The more difficult flight was associated with poorer performance, increased subjective effort ratings, and smaller secondary task P300s. Within each flight, P300 amplitude was negatively correlated with deviations from command headings indicating that P300 amplitude was a sensitive workload metric both between and within the flight missions. Author

**A88-10168****AN INVESTIGATION OF THE RELATIONSHIP BETWEEN BASIC ATTRIBUTES TEST SCORES AND LEARNING TO FLY A VTOL SIMULATOR**

DARLENE A. COUCHMAN (New Mexico State University, Las Cruces) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 185-189. refs (SAE PAPER 861668)

Experiments were performed to study the relationship between the scores of a battery of basic attributes tests and proficiency in learning to fly a VTOL simulator. Twelve nonpilot male Air Force ROTC students participated in the study. Dynamic variables in the simulated vehicle's control system were manipulated in unpredictable ways and different flight maneuvers were called for without warning. K.K.

**A88-10951\*** Texas Univ., Austin.**EXPLORATIONS IN ACHIEVEMENT MOTIVATION**

ROBERT L. HELMREICH (Texas, University, Austin) American Psychological Association, Annual Meeting, Washington, DC, Aug. 24, 1982, Paper. 10 p. refs (Contract NAG2-137)

Recent research on the nature of achievement motivation is reviewed. A three-factor model of intrinsic motives is presented and related to various criteria of performance, job satisfaction and leisure activities. The relationships between intrinsic and extrinsic motives are discussed. Needed areas for future research are described. Author

**A88-10952\*** Texas Univ., Austin.**PILOT SELECTION AND TRAINING**

ROBERT L. HELMREICH (Texas, University, Austin) American Psychological Association, Annual Meeting, Washington, DC, Aug. 24, 1982, Paper. 12 p. (Contract NAG2-137)

Personality and situational factors relevant to individual and group performance in highly demanding environments, such as those faced by astronauts or by jet transport crew, are discussed. It is emphasized that although technical competence and proficiency in pilot selection are prerequisites for safety, operating a modern jet transport is a group endeavor that requires the effective coordination of the entire crew. A self-report test battery for measuring positive and negative personality traits of pilot

candidates, termed the Personal Characteristics Inventory, is described. I.S.

**A88-10958\*#** Texas Univ., Austin.

# **THE ROLE OF PSYCHOLOGISTS IN FUTURE SPACEFLIGHT**

ROBERT L. HELMREICH (Texas, University, Austin) SPACEFAIR '85, Meeting, Boston, MA, Apr. 14, 1985, Paper. 9 p. (Contract NAG2-137)

The need for psychologists to have a more active role in planning space missions is discussed. It is suggested that it would be beneficial if psychologists conducted research aimed at optimizing the organization, composition, and performance of crews; participated in the selection and training of crews; and monitored the actual performance and adjustment of crews during missions. The areas which require further research and the types of research strategies to be implemented are described. The desirable traits for future space personnel and the role of psychologists in mission control are examined. I.F.

**A88-10960\*#** Texas Univ., Austin.

# **WHAT CHANGES AND WHAT ENDURES - THE CAPABILITIES AND LIMITATIONS OF TRAINING AND SELECTION**

ROBERT L. HELMREICH (Texas, University, Austin) Irish Air Line Pilots Association and Aer Lingus, Flight Operations Symposium, Dublin, Ireland, Oct. 19, 20, 1983, Paper. 13 p. refs (Contract NAG2-137)

The contributions of psychology to aviation in the areas of selection, training, and evaluation, and the implementation of new technologies are discussed. The concept of personality traits versus modification of human behavior through principles of learning are analyzed. Particular consideration is given to achievement motivation (defined in terms of mastery, work, and competitiveness) and the differences between traits and attitudes. It is argued that personality traits are important dimensions of the self and are useful measures of individual differences. The selection of individuals with desired personality characteristics and the training of personnel to improve crew coordination, flight-deck management, and interpersonal efficacy are examined. I.F.

**A88-10961\*#** Texas Univ., Austin.

# **TRAINING - BEHAVIORAL AND MOTIVATIONAL SOLUTIONS?**

ROBERT L. HELMREICH (Texas, University, Austin) Air Line Pilots Association, Beyond Pilot Error - A Symposium of Scientific Focus, Washington, DC, Dec. 6-8, 1983, Paper. 11 p. refs (Contract NAG2-137)

Psychological factors which govern interpersonal activities in the cockpit are examined. It is suggested that crew members should be selected based on personality characteristics required for the position and that training does not cause long lasting personality changes, it only teaches and improves task performance skills. The effects of mindlessness as defined by Langer (1978) and the attribution theory of Jones and Nisbett (1971) on flight deck communications and cockpit management are described. The needs for a new system of training crew members, with emphasis on strategies that induce cognitive processes and awareness, and for field investigations of pilots are discussed. I.F.

**A88-11325**

# **PSYCHOPHYSIOLOGICAL PRINCIPLES OF SETTING WORK NORMS IN FLIGHT TRAINING [PSIKHOFIZIOLOGICHESKIE PRINTSIPIY NORMIROVANIYA TRUDA V PROTSESSE LETNOGO OBUCHENIYA]**

N. I. FROLOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), June 1987, p. 48-50. In Russian.

The methods used in norm setting for the activities of pilots and pilot trainees are discussed together with the systems of activity grading. It is emphasized that the daily work norm should not only be based on the flight activity, but that the ground activities of a pilot should also be taken into consideration. It is shown that the maximal learning of piloting skills occurs only in cases when the physiological condition of the organism is maximal. The appearance of the symptoms of the motor-vegetative system activation under the conditions of the work load increase precedes

the onset of a slack in the work capacity; thus, these physiological symptoms can be used for setting individual flight and work limits. I.S.

**A88-12109**

# **INVESTIGATING THE RELIABILITY OF PILOT PERFORMANCE DURING LONG-TERM FLIGHTS IN THE AUTOMATIC CONTROL MODE [ISLEDOVANIYE NADEZHNOСТИ DEIATEL'NOSTI LETCHIKA PRI VYPOLNENII DLITEL'NYKH POLETOV V AVTOMATICHESKOM REZHIME UPRAVLENIYA]**

V. A. PONOMARENKO, V. G. KOSTRITSYA, S. V. EGOROV, and A. A. OBOZNOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), May 1987, p. 43-45. In Russian.

Changes in the quality of flight control and the indices of alertness of pilots performing long-term flights in the automatic control mode were investigated in 11 healthy trained pilots 'flying' a simulator under the conditions of a monotonous night-time flight. A six-hour-long route consisted of 12 30-min-long stereotype sections. The operator had to control the continuously changing values of 'flight' parameters and to report their changes; in addition, they had to attend to the flight route and to readjust the route every 30 min. The results of individual assessments indicated that in the first 2.5 hours of flight, the feeling of sleepiness and dullness increased steadily. Later, the signs of sleepiness decreased, while the perception of dullness decreased or increased depending upon the conditions of flight. It is suggested that sensory monotony is the most detrimental and potentially dangerous factor in long-term flights in the automatic control mode. I.S.

**A88-12641**

# **INTERNAL MODELS, TRACKING STRATEGIES, AND DUAL-TASK PERFORMANCE**

RAY E. EBERTS (Purdue University, West Lafayette, IN) Human Factors (ISSN 0018-7208), vol. 29, Aug. 1987, p. 407-419. refs (Contract NR PROJECT 154-460; N00014-81-K-0034)

The effects of internal models and tracking strategies on workload were investigated in a dual-task, second-order tracking and auditory detection experiment. Internal models and tracking strategies were manipulated by providing subjects with augmenting cues. A control group was compared with two groups provided with different kinds of display augmentation, parabola or point cues, during single-task tracking training. The display augmentation had the effect of changing tracking strategy as subjects practiced on cued and noncued trials, and it had an effect on the internal models developed. Both point and parabola augmentation reduced workload when displayed on the cued trials. On the noncued trials, the parabola augmentation training had the effect of reducing the workload, compared with the point augmentation, even if the parabola cues were not displayed. A control group that did not change strategy during training also had low workload requirements in the dual task. The results indicate that a consistent tracking strategy or the development of a visually based internal model is needed to lessen the workload. Author

**A88-12642**

# **MODELS OF PROCEDURAL CONTROL FOR HUMAN PERFORMANCE SIMULATION**

PAUL J. STICHA (Human Resources Research Organization, Alexandria, VA) Human Factors (ISSN 0018-7208), vol. 29, Aug. 1987, p. 421-432. refs (Contract MDA903-81-C-0517)

This paper describes and evaluates two general techniques to simulate human performance of procedural tasks. A procedural task is characterized as a partial ordering of task elements in which the control of task-element sequencing is represented within the task, rather than as an interaction between the task and the environment in which the task is performed. The primary concern in simulating the performance of procedures is determining the mechanism that controls task-element sequencing. Two modeling frameworks have been used to represent task-element sequencing. The first method represents the constraints on task-element sequencing directly in a network. A second method represents sequencing constraints indirectly as a set of production rules. Both



frameworks offer considerable generality and flexibility in the kinds of structures that can be represented. The relative advantages of the two methods depend upon the questions addressed by the model and the characteristics of the tasks being modeled.

Author

#### A88-12643

##### **EFFECT OF PIXEL HEIGHT, DISPLAY HEIGHT, AND VERTICAL RESOLUTION ON THE DETECTION OF A SIMPLE VERTICAL LINE SIGNAL IN VISUAL NOISE**

BERNARD MOULDEN and FRED KINGDOM (Reading, University, England) Human Factors (ISSN 0018-7208), vol. 29, Aug. 1987, p. 433-445. Research supported by the Ministry of Defence (Procurement Executive). refs

Spatial resolution is one of the parameters that engineers designing digital displays must consider. Three experiments are described that investigate the effects of vertical spatial resolution and the interrelated parameters, pixel height and display height, on the visibility of straight vertical line signals in visual noise. A signal detection analysis of the results showed that detection efficiency was unaffected by vertical resolution and pixel height, whereas an increase in display/signal height resulted in a decline in efficiency. The decline is attributed to the increasing difficulty the visual system encounters when integrating luminance over an increasing spatial extent. It is suggested that in practical digital displays of the kind described here, pixels should be as short as possible in order that the available display information be compressed into the smallest possible height.

Author

**A88-12958\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

##### **EFFECTS OF PROPOSED PREFLIGHT ADAPTATION TRAINING ON EYE MOVEMENTS, SELF-MOTION PERCEPTION, AND MOTION SICKNESS - A PROGRESS REPORT**

D. E. PARKER (NASA, Johnson Space Center, Houston, TX), M. F. RESCHKE (Miami University, Oxford, OH), H. E. VON GIERKE (USAF, Armstrong Medical Research Laboratory, Wright-Patterson AFB, OH), and C. S. LESSARD (Texas A & M University, College Station, TX) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A42-A49. USAF-supported research. refs

(Contract NAS9-17413; NAS9-17267)

The preflight adaptation trainer (PAT) was designed to produce rearranged relationships between visual and otolith signals analogous to those experienced in space. Investigations have been undertaken with three prototype trainers. The results indicated that exposure to the PAT sensory rearrangement altered self-motion perception, induced motion sickness, and changed the amplitude and phase of the horizontal eye movements evoked by roll stimulation. However, the changes were inconsistent.

Author

#### A88-12981

##### **ADAPTIVE CHANGES IN PERCEPTION OF BODY ORIENTATION AND MENTAL IMAGE ROTATION IN MICROGRAVITY**

GILLES CLEMENT, ALAIN BERTHOZ, and FRANCIS LESTIENNE (CNRS, Laboratoire de Physiologie Neurosensorielle, Paris, France) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A159-A163. refs

The perception of the subjective body orientation with respect to a foot reference basis, and the adaptation of mental image rotation have been investigated before, during, and after a 7-d spaceflight. The findings show that the body is tilted forward in darkness and in stabilized vision, which indicates a predominant role of vision in such orientational tasks performed in microgravity. Furthermore, perception of head angular rotation in pitch and roll axes seems to be altered in microgravity, whereas head

displacements in yaw are estimated correctly. Subjects' capability to rotate mentally the image of the visual environment increased during the flight. Memorized writing was affected in microgravity, especially concerning the layout of letters corresponding to the vertical direction.

Author

#### A88-12982

##### **RESOLVING PERCEPTUAL CONFLICTS - THE COGNITIVE MECHANISM OF SPATIAL ORIENTATION**

A. D. FRIEDERICI and W. J. M. LEVELT (Max-Planck-Institut fuer Psycholinguistik, Nijmegen, Netherlands) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A164-A169. Research supported by the Max-Planck-Gesellschaft zur Foerderung der Wissenschaften und BMFT. refs

The cognitive mechanisms of spatial orientation were studied in an experiment varying different perceptual cues systematically: the retinal, the visual background, the vestibular, and the somatosensory information. Verbal descriptions of visually presented arrays were required under different head positions (straight/tilt) and under different gravity conditions (1 G/micro G). Results for two subjects clearly show that different coordinate systems are used under the two gravity conditions. Under 1 G it is the gravitational vertical which is chosen for primary reference, whereas under microgravity retinal information is primary. Conflicts between competing pieces of sensory information are solved by weighting the perceptual cues differently. The finding that consistent assignment can be made immediately after first exposure to weightlessness indicates that mental representations of space can be used independently of perceptual input parameters.

Author

**N88-10484#** Technische Hogeschool, Delft (Netherlands). Dept. of Mathematics and Informatics.

##### **MODELING OF HUMAN JUDGEMENT IN MULTICRITERIA ANALYSIS USING PAIRWISE COMPARISON [MODELISATION DU JUGEMENT HUMAIN DANS L'ANALYSE MULTICRITERE AU MOYEN DE COMPARAISONS PAR PAIRES]**

F. A. LOOTSMA 1987 22 p In FRENCH Presented at Laboratoire d'Analyse et Modelisation de Systemes pour l'Aide a la Decision Conference, Paris, France, 9 Dec. 1986 (REPT-87-01; B8703782; ISSN-0920-2358; ETN-87-90834)

Avail: NTIS HC A03/MF A01

A class of discrete geometrical scales to express degree of judgement (indifferent, weak preference, preference, etc.) when comparing one stimulus with another is discussed. Fuzzy numbers are used to express preferential judgements, given the vagueness of the degrees and the imprecision of the decision makers. Only numbers with a triangular characteristic function are used since the parameters follow a transparent algebra. In a simplified model in which all the judgements are equally imprecise, an analytical solution which enables the propagation of fuzziness in a hierarchy of decision levels to be studied is obtained.

ESA

**N88-10485#** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Vision Group.

##### **MASKING EFFECTS OF FINE AND COARSE GRAIN PICTORIAL NOISE**

A. VANMEETEREN and J. M. VALETON Oct. 1985 38 p (Contract AFOSR-0334)

(IZF-1985-21; TDCK-93624; ETN-87-90856) Avail: NTIS HC A03/MF A01

In order to evaluate the potential gain of noise suppression techniques, visual detection of sine wave gratings in images with fine and coarse grain pictorial noise was investigated. Threshold modulations were measured psychophysically as a function of spatial frequency. An important part of the threshold elevations caused by pictorial noise can be explained as masking by same spatial frequency components in the noise. This masking effect can be reduced by intelligent image processing according as a-priori knowledge of signal and noise is available. The fraction of information utilized can possibly be increased from 10% to nearly

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100%. The detection of lower spatial frequencies can be moderately improved by blurring of the image, whereas, the detection of higher spatial frequencies can be improved by differentiation of the image. ESA

**N88-10486#** Royal Signals and Radar Establishment, Malvern (England).

### **A STUDY OF THE PERFORMANCE OF AUTOMATIC SPEECH RECOGNISERS WITH SPEECH IMPAIRED CHILDREN**

D. C. SMITH and M. J. RUSSELL Apr. 1987 32 p (RSRE-MEMO-4040; BR102763; ETN-87-90980) Avail: NTIS HC A03/MF A01

The feasibility of using automatic speech recognition devices with speech impaired children was assessed, using five children with various speech and language problems. Structured conversations between a speech therapist and individual children were recorded in an informal play setting at the children's school. Two children with reasonably normal speech were also recorded. The recordings were preprocessed, edited and annotated. Isolated word recognition experiments were performed using computer simulation. Results suggest that speech recognition techniques are not sufficiently powerful to accommodate the degree of variability which occurs in the speech of children with the types of speech impairment considered. ESA

**N88-10487#** Royal Signals and Radar Establishment, Malvern (England).

### **PSYCHOPHYSICAL CONSIDERATIONS IN MEASURING MRTD WITH STARING ARRAYS**

K. ST. J. MURPHY May 1987 13 p (RSRE-MEMO-4031; BR102762; ETN-87-90981) Avail: NTIS HC A03/MF A01

Large variations in minimum resolvable temperature difference (MRTD) data are partly attributed to inconsistent observer response biases. Psychophysical techniques which can minimize the errors introduced by such observer response bias are described. The techniques are applied to measurements of MRTD performance for staring array thermal imagers. ESA

**N88-10879\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### **A SYNOPSIS OF THE EVA TRAINING CONDUCTED ON EASE/ACCESS FOR STS-61-B**

KATHRYN A. HAVENS /in NASA. Langley Research Center, Hampton, Va. Space Construction p 153-182 Oct. 1987 Avail: NTIS HC A14/MF A01 CSCL 051

Experimental Assembly of Structure in EVA (EASE)/Assembly Concept for Construction of Erectable Space Structures (ACCESS) training problems; photography/television coverage; training schedules; flight data file (FDF), and flight rules production are summarized. B.G.

**N88-11369#** Association pour le Developpement de l'Enseignement et de la Recherche en Systematique Appliquee, Verrieres-le-Buisson (France).

### **A RESEARCH ON PILOT PERFORMANCE IN THE CASE OF AIRCRAFT MALFUNCTION [UNE RECHERCHE SUR LE PILOTAGE EN SITUATION DE PANNE EN VOL]**

DIDIER VIARD Mar. 1987 6 p In FRENCH (Contract DRET-83-34-428-00-470-75-01) (ETN-87-90652) Avail: NTIS HC A02/MF A01

Pilot reactions to malfunctions in 11 simulations carried out with a group of pilot trainees were studied. The studied variables included type of aircraft malfunction, individual experience, psychological factors, flight duration, and pilot workload. The role of workload, a large effect of personality factors, and a strong interaction with the type of malfunction are noted. ESA

**N88-11370#** Association pour le Developpement de l'Enseignement et de la Recherche en Systematique Appliquee, Verrieres-le-Buisson (France).

### **A RESEARCH ON PILOT PERFORMANCE IN A FLIGHT INCIDENT SITUATION Final Report [UNE RECHERCHE SUR LE PILOTAGE EN SITUATION DE PANNE EN VOL]**

D. VIARD and B. GANGLOFF Mar. 1987 188 p In FRENCH (Contract DRET-83-34-428-00-470-75-01) (ETN-87-90653) Avail: NTIS HC A09/MF A01

Pilot behavior during flight emergencies and incidents is studied to provide elements for the design of automated aircraft and pilot training and selection. The analysis includes experienced pilot interviews, flight incidents or accidents report analysis, observation of actual flight pilot performance, and flight simulator experiments in a pilot training institution. ESA

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### **MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

Includes human engineering; biotechnology; and space suits and protective clothing.

#### **A88-10152**

### **AEROSPACE BEHAVIORAL ENGINEERING TECHNOLOGY CONFERENCE, 5TH, LONG BEACH, CA, OCT. 13-16, 1986, PROCEEDINGS**

Conference sponsored by SAE. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE P-184), 1986, 318 p. For individual items see A88-10153 to A88-10174. (SAE P-184)

The conference presents papers on fitness for duty, rotorcraft as innovative technology for future systems, Space Station and aircraft windows, air transport, intuitive situation displays, workload, fly by wire transport aircraft, human attributes and aircrew effectiveness, simulation technology, and color for electronic displays. Topics include the development of three-dimensional audio signals, Space Station viewing requirements, an integrated display for vertical situation awareness in commercial transport aircraft, the advantages of a primary flight display, and evaluating the subjective workload of directional orientation tasks with varying display formats. Consideration is also given to airline requirements on a fly-by-wire aircraft, the relationship between basic attributes test scores and learning to fly a VTOL simulator, flight simulator visual systems, and national and international measurement techniques for color determination. K.K.

**A88-10154\*** Psycho-Linguistic Research Associates, Menlo Park, Calif.

### **VERSATILE SIMULATION TESTBED FOR ROTORCRAFT SPEECH I/O SYSTEM DESIGN**

CAROL A. SIMPSON (Psycho-Linguistic Research Associates, Menlo Park, CA) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 33-37. USAF-supported research. (Contract NAS2-12425) (SAE PAPER 861661)

A versatile simulation testbed for the design of a rotorcraft speech I/O system is described in detail. The testbed will be used to evaluate alternative implementations of synthesized speech displays and speech recognition controls for the next generation of Army helicopters including the LHX. The message delivery logic is discussed as well as the message structure, the speech recognizer command structure and features, feedback from the recognizer, and random access to controls via speech command. K.K.



**A88-10155\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**SPACE STATION VIEWING REQUIREMENTS**

FRANCES E. MOUNT and JAMES L. LEWIS (NASA, Johnson Space Center, Houston, TX) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 41-43.

(SAE PAPER 861754)

Concern based on historical precedent led to early investment of resources to identify Space Station viewing requirements in order that they could be transferred to module window designs, cupolas, indirect viewing methods (e.g., closed circuit television), and implemented in cost models tracking overall station configuration weight and cost. Previous space history and earth based analogs were used to identify needs and requirements relevant to long term missions. Author

**A88-10157**

**PRESENTATION OF INFORMATION ON MULTIFUNCTION DISPLAYS - ABNORMAL AND EMERGENCY SPACECRAFT OPERATIONS**

GARY GERSHZOHN (McDonnell Douglas Astronautics Co., Saint Louis, MO) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 51-58.

(SAE PAPER 861756)

The capability of a multifunction display system to present data regarding malfunctioning manned spacecraft systems is illustrated. Three different stages of cognitive processing are identified, and associated spacecraft formats are developed. System architecture provides for the display of required information tailored to crewmember requirements in identifying, understanding, and solving malfunctions via a simple multifunction display interface. Two sets of formats were produced which illustrate traditional display strategies and cognitive representations. Formats were presented to subjects using a slide projector and data were collected to identify any significant differences between the two methods of information display. Results indicated no statistically significant differences in performance which were attributed to the use of straightforward failure modes and effects. Author

**A88-10158**

**AN INTEGRATED DISPLAY FOR VERTICAL SITUATION AWARENESS IN COMMERCIAL TRANSPORT AIRCRAFT**

ROGER HOUCK, BRIAN D. KELLY, and JOHN WIEDEMANN (Boeing Commercial Airplane Co., Seattle, WA) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 61-64.

(SAE PAPER 861770)

The need for a sideview-presentation vertical situation display (VSD) for use in commercial transport aircraft is demonstrated. The preliminary conceptual VSD format includes an inside-out presentation with a moving scale and vertical map translating around a fixed airplane symbol. The information is scaled along altitude and distance axes to permit present, predicted, and future altitude requirements to be integrated with other relevant vertical situational information. It is believed that the completed VSD concept will improve the flightcrew's awareness of the aircraft's spatial position throughout the flight. K.K.

**A88-10160\*** Boeing Commercial Airplane Co., Seattle, Wash.  
**COMPARISON OF PROGRAMMABLE LEGEND KEYBOARD AND DEDICATED KEYBOARD FOR CONTROL OF THE FLIGHT MANAGEMENT COMPUTER**

JEAN M. CRANE, GEORGE P. BOUCEK, JR. (Boeing Commercial Airplane Co., Seattle, WA), and WAYNE D. SMITH (Boeing Military Airplane Co., Wichita, KS) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 83-90. refs

(Contract NAS1-17635)

(SAE PAPER 861772)

A study is described which compares two types of input devices used to operate a flight management computer: a programmable legend (multifunction) keyboard and a conventional (dedicated) keyboard. Pilot performance measures, subjective responses, and a timeline analysis were used in evaluating the two keyboard concepts. A discussion of the factors to be considered in the implementation of a multifunction keyboard is included. Author

**A88-10162**

**THE ADVANTAGES OF A PRIMARY FLIGHT DISPLAY**

J. E. HUTCHINSON (International Federation of Air Line Pilots Associations, Egham, England) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 101-104.

(SAE PAPER 861730)

The features of a primary flight display (PFD) are discussed as well as its advantages over conventional instrumentation. The present PFD is part of the electronic flight instrument system which is standard on the current series of Airbus models. Consideration is given to failure indications, the airspeed scale, the flight path vector (FPV), and the FPV with head-up display. K.K.

**A88-10169**

**FLIGHT SIMULATOR VISUAL SYSTEMS - AN OVERVIEW**

R. E. BARRETTE (CAE Electronics, Ltd., Montreal, Canada) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 193-198.

(SAE PAPER 861708)

Present-day flight simulator visual systems are evaluated in terms of their capabilities and limitations. Particular attention is given to the image generator and the display combinations employed as well as their application areas. It is believed that video disk technology will eventually supply the lowest cost requirements such as general aviation trainers. In the display area, the author anticipates a gradual evolution towards the greater use of projection-based off-axis wide-angle continuous mirror displays in the transport world and helmet-mounted displays in the military training role. K.K.

**A88-10171**

**NATIONAL AND INTERNATIONAL MEASUREMENT TECHNIQUES FOR COLOR DETERMINATION**

JUSTIN RENNILSON IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 209-217. refs

(SAE PAPER 861693)

The number and types of parameters which require measurement if colors are to be represented accurately on a self-luminous display unit are presented. Efforts made by national and international organizations to determine these parameters are reviewed. The four basic types of measurements used are broad-band, visual, photographic, and spectroradiometric. K.K.

**A88-10172****EFFECTIVE USE OF COLOR ON AVIONICS DISPLAYS**

GERALD M. MURCH and JOANN M. TAYLOR (Tektronix, Inc., Beaverton, OR) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 219-225. refs

(SAE PAPER 861694)

The principles behind effective color displays for avionics applications are reviewed. Color use in text and symbolics as well as in nonalphanumeric displays is examined in terms of the perceptual, physiological, and cognitive principles applicable to the human interface. It is noted that the benefits of color as an attention getter, information grouper, and value assigner are lost if too many colors or improper color combinations are employed. K.K.

**A88-10173****U.S. AIR FORCE COLOR DISPLAY ISSUES**

DAVID L. POST (USAF, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 227-247. refs

(SAE PAPER 861695)

The ways in which the USAF uses electronic color displays are discussed with emphasis placed on related display design issues. Airborne displays are of particular interest. Among the issues addressed are luminance, ambient illumination, the spectral characteristics of the display, color selection and tolerances, color-code size, formatting, resolution, size, weight, power requirements, and ruggedness. K.K.

**A88-10174****COLOR FORMATTING ISSUES IN PICTORIAL DISPLAYS**

JOHN M. REISING, JOHN P. ZENYUH (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and ROBIN L. MARTIN (Boeing Military Airplane Co., Seattle, WA) IN: Aerospace Behavioral Engineering Technology Conference, 5th, Long Beach, CA, Oct. 13-16, 1986, Proceedings . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 249-253. 5 p. refs

(SAE PAPER 861696)

The use of color pictorial display formats in aircraft cockpits to integrate and simplify available information is discussed. Existing color coding conventions are reviewed as well as applications that go beyond them. It is noted that the elements of the multiple CRT cockpit's HUD represent a combination of traditional and new coding approaches. The amber coding of threat lock-ons and red indication of missile launches are examples of traditional uses of color coding while the cyan ownship symbol addresses new applications in color coding. K.K.

**A88-11393****A TWO-CHANNEL TRACKING SYSTEM [DVUKHKANAL'NAIA SLEDIASHCHAIYA RADIOTEKHNIЧЕСКАЯ СИСТЕМА]**

S. G. RASSOMAKHIN and F. V. LUCHENKO Radiotekhnika (Kharkov) (ISSN 0485-8972), no. 76, 1986, p. 58-61. In Russian.

A man-machine system is described which involves the use of two human operators to track a moving object. Carrying out the same functions, the operators compensate for each other's errors, leading to an improvement in the total accuracy of the system. In this system, operator delay is practically eliminated and tracking quality is improved. A block diagram of the system is presented.

B.J.

**A88-12434#****DEVELOPMENT OF METHODS FOR PREVENTION OF ACCELERATION INDUCED BLACKOUT AND UNCONSCIOUSNESS IN WORLD WAR II FIGHTER PILOTS - LIMITATIONS: PRESENT AND FUTURE**

EARL H. WOOD (Mayo Medical School, Rochester, MN) (International Union of Physiological Sciences, Commission on Gravitational Physiology, Annual Meeting, 8th, Tokyo, Japan, Nov. 4-8, 1986) Physiologist, Supplement (ISSN 0031-9376), vol. 30, Feb. 1987, p. S-27 to S-30. refs

(Contract N66001-87-C-0079)

The major determinant of human tolerance to high Gz when in the upright sitting position is arterial blood pressure; thus, the effectiveness of an anti-G suit is directly proportional to its capability of producing arterial hypertension at heart level during positive acceleration. However, the very high levels of protection (of a combination of the G-suit and the M-1 straining muscle maneuver) required to prevent the loss of consciousness at acceleration higher than 7-8 Gz carries the potential danger of injuries to the lungs and the cardiovascular systems. Although it has been shown that in the prone position humans can tolerate very high accelerations without visual symptoms, there occurs at high G levels (endured in the supine position) a severe dorsalward displacement of the heart with the consequent overdistension of the ventral region of the lungs. Thus, protection against the hazards of exposure to very high G still presents a challenge to the aerospace medical research and engineering communities. I.S.

**A88-12547#****MODEL BASED HEALTH MONITORING FOR REUSABLE LAUNCH VEHICLES**

DAVID J. SIRAG, JR., SHARAYU TULPULE (United Technologies Research Center, East Hartford, CT), and STEPHEN L. PATRICK (United Technologies Corp., Huntsville, AL) IN: AIAA Computers in Aerospace Conference, 6th, Wakefield, MA, Oct. 7-9, 1987, Technical Papers . Washington, DC, American Institute of Aeronautics and Astronautics, 1987, p. 157-164. refs

(AIAA PAPER 87-2797)

A methodology for developing a health monitoring system for reusable launch vehicles is proposed. The methodology is based on using explicit models of the vehicles for each part of the health monitoring system. The basic system model for the monitoring system and schemes for decomposing the model are discussed. Some of the formal models used are: qualitative, analytical, empirical, and life. Signal conditioning, pattern recognition, and qualitative reasoning techniques, which are computational methods for sensor data analysis, are examined. The architecture for a health monitoring system are described. An example, which illustrates the design methodology, of the development of a health monitoring system for a simple lube system is presented. I.F.

**A88-12639\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**PERSPECTIVE TRAFFIC DISPLAY FORMAT AND AIRLINE PILOT TRAFFIC AVOIDANCE**

STEPHEN R. ELLIS, MICHAEL W. MCGREEVY (NASA, Ames Research Center, Moffett Field; California, University, Berkeley), and ROBERT J. HITCHCOCK (San Jose State University, CA) Human Factors (ISSN 0018-7208), vol. 29, Aug. 1987, p. 371-382. refs

(Contract NCC2-86)

Part-task experiments have examined perspective projections of cockpit displays of traffic information as a means of presenting aircraft separation information to airline pilots. Ten airline pilots served as subjects in an experiment comparing the perspective projection with plan-view projections of the same air traffic situations. The pilots' task was to monitor the traffic display in order to decide if an avoidance maneuver was needed. Pilots took more time to select avoidance maneuvers with a conventional plan-view display than with an experimental perspective display. In contrast to previous results, if the pilots selected a maneuver with the perspective display, they were more likely to choose one with a vertical component. Tabulation of the outcomes of their

initial avoidance decisions with both perspective and plan-view displays showed that they were more likely to achieve required separation with maneuvers chosen with the aid of perspective displays. Author

**A88-12962\*** Texas Univ., Dallas.

**ECHOCARDIOGRAPHIC MEASUREMENTS OF LEFT VENTRICULAR MASS BY A NON-GEOMETRIC METHOD**

BEATRIZ PARRA, JAY BUCKEY, DAVID DEGRAFF, F. ANDREW GAFFNEY, and C. GUNNAR BLOMQVIST (Texas, University, Dallas) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A64-A68. refs  
(Contract NAS9-16044)

The accuracy of a new nongeometric method for calculating left ventricular myocardial volumes from two-dimensional echocardiographic images was assessed in vitro using 20 formalin-fixed normal human hearts. Serial oblique short-axis images were acquired from one point at 5-deg intervals, for a total of 10-12 cross sections. Echocardiographic myocardial volumes were calculated as the difference between the volumes defined by the epi- and endocardial surfaces. Actual myocardial volumes were determined by water displacement. Volumes ranged from 80 to 174 ml (mean 130.8 ml). Linear regression analysis demonstrated excellent agreement between the echocardiographic and direct measurements. Author

**A88-12963**

**ULTRASOUND TECHNIQUES IN SPACE MEDICINE**

O. I. U. ATKOV, V. S. BEDNENKO, and G. A. FOMINA (Institut Mediko-Biologicheskikh Problem; Nauchno-Issledovatel'skii Institut Transplantologii i Iskusstvennykh Organov, Moscow, USSR) (NASA, Universities Space Research Association, Baylor University, and International Academy of Astronautics, International Man in Space Symposium, 7th, Houston, TX, Feb. 10-13, 1986) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Sept. 1987, p. A69-A73. refs

Ultrasound examinations have been performed on 15 cosmonauts who have remained in orbit for flights ranging from 2.5 to 8 months in duration. Soviet researchers have combined hemodynamic assessments with parallel attempts to develop improved ultrasound techniques and equipment for use onboard space stations. These techniques and equipment are reviewed, as are findings relative to exercise effects on hemodynamic changes. In general, longitudinal echocardiographic studies have suggested that (1) few differences exist between resting preflight and on-orbit cardiac contractility measures; (2) declines in orthostatic stability after long-term flights are not due to deterioration of the myocardial functional state; and (3) lower stroke volumes and heart rate increases occurring during exertion may be considered compensatory hemodynamic resettlements rather than indications of a disturbed left ventricular contractility. Author

**A88-13099\*** Georgia Inst. of Tech., Atlanta.

**MULTIMODAL USER INPUT TO SUPERVISORY CONTROL SYSTEMS - VOICE-AUGMENTED KEYBOARD**

CHRISTINE M. MITCHELL (Georgia Institute of Technology, Atlanta) and MICHELLE G. FORREN (Scientific Atlanta, Inc., GA) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-17, July-Aug. 1987, p. 594-607. refs  
(Contract NAS5-28575)

The use of a voice-augmented keyboard input modality is evaluated in a supervisory control application. An implementation of voice recognition technology in supervisory control is proposed: voice is used to request display pages, while the keyboard is used to input system reconfiguration commands. Twenty participants controlled GT-MSOCC, a high-fidelity simulation of the operator interface to a NASA ground control system, via a workstation equipped with either a single keyboard or a voice-augmented keyboard. Experimental results showed that in all cases where significant performance differences occurred,

performance with the voice-augmented keyboard modality was inferior to and had greater variance than the keyboard-only modality. These results suggest that current moderately priced voice recognition systems are an inappropriate human-computer interaction technology in supervisory control systems. Author

**A88-13106**

**INTERFACES FOR ADVANCED COMPUTING**

JAMES D. FOLEY (George Washington University, Washington, DC) Scientific American (ISSN 0036-8733), vol. 257, Oct. 1987, p. 127-130, 132, 134, 135.

Supercomputer-created 'artificial realities' that facilitate user-computer communication are discussed. Improved display monitors and head-mounted displays and their accessories are addressed. The DataGlove, which translates hand and finger movements into electrical signals, and may provide major advances in user-computer interaction, is described. Other tactile-feedback technologies are examined, and voice- and gesture-recognition systems are discussed. C.D.

**N88-10488#** Aviation Systems Concept, Inc., Annandale, Va.

**REPORT OF SAFETY SURVEY: HUMAN INTEGRATION OF APPROACH CHARTS Final Report**

WILLIAM J. COX and C. W. 'BILL' CONNOR May 1987 197 p  
Prepared in cooperation with Midwest Systems Research, Inc., Dayton, Ohio  
(Contract F33615-85-C-3623)

(DOT/FAA/PM-87/15) Avail: NTIS HC A09/MF A01

Results of a safety survey conducted among pilots associated with the USAF and civil flight operations are presented. The objective of the survey was to determine the scope of a previously identified safety issue: The need to establish formal human performance criteria for the development and evaluation of instrument approach procedures and charts. A total of 1,037 (of 6,000) survey forms were completed by pilots and returned for a review of the answers and volunteered comments to 30 survey questions. These questions related to these terminal instrument flight procedures and charting topics: information requirements; terrain and obstruction; runway information requirements; arrival and departure navigation procedures requirements; information location, symbology, and packaging. The study provides 6 recommendations which address several needs. These recommendations are listed and briefly discussed. Author

**N88-10489#** British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.

**TELEOPERATION AND CONTROL STUDY Final Report**

J. S. SHEPPARD, comp. Paris, France ESA Nov. 1986 556 p

(Contract ESA-6118/84)

(BAE-TP-8268; ESA-CR(P)-2413; ETN-87-90549) Avail: NTIS HC A24/MF A01

Requirements for a servicing manipulator teleoperator system were derived using two mission model scenarios. The first scenario introduces the problem of communication time delays within the overall manipulator teleoperator control system, associated with the human operator being located on the ground while controlling a manipulator on a free-flying servicing vehicle, servicing a payload on a platform or satellite docked to it, in low Earth orbit. The second scenario has the human operator located on the shuttle aft deck controlling a manipulator servicing a payload in the cargo area. This scenario is intended to demonstrate the operational capability of the service manipulator system using the Robotic Servicing Experiment. A ground based supervisor is also assumed for this mission, permitting a teleoperation-control experiment with time delay, to be performed as required. It is concluded that true teleoperation and control of a remote manipulator cannot be readily achieved in the presence of a communications time delay. ESA

**N88-10490#** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Thermal Physiology Group.

## LOSS OF PERFORMANCE DUE TO MILITARY CLOTHING AND EQUIPMENT

W. A. LOTENS Jul. 1986 32 p

(Contract A83/KL/105)

(IZF-1986-13; TD-86-3296; ETN-87-90857) Avail: NTIS HC A03/MF A01

Clothing and equipment effects on physical performance were assessed in coordination tests, sprinting and running, as well as handgrenade throwing and obstacle course. Average loss of performance is 0% to 2% for fatigues, insulative liner and helmet; 4% to 6% for outer garment, combat boots, chemical warfare CW-suit, CW-overboots, and respirator; and 7% and 13.5% for weapon carrying and fighting order (webbing with entrenching tool, canteen, rucksack and respirator in bag) respectively. The figures vary between statistically significant and very significant. Few interactions are significant. Both CW-gear with respirator and fighting order with weapon tend to regressive interaction. A model for the prediction of the loss of performance when combining items is presented. ESA

**N88-10491\*#** Signal Research Center, Inc., Des Plaines, Ill. **CATALYTIC PROCESSES FOR SPACE STATION WASTE CONVERSION Final Report, 1 Oct. 1985 - 31 Jul. 1986**

M. W. SCHOONOVER and R. A. MADSEN (AiResearch Mfg. Co., Torrance, Calif.) Jul. 1986 43 p

(Contract NAS2-12265)

(NASA-CR-177423; NAS 1.26:177423) Avail: NTIS HC A03/MF A01 CSDL 06K

Catalytic techniques for processing waste products onboard space vehicles were evaluated. The goal of the study was the conversion of waste to carbon, wash water, oxygen and nitrogen. However, the ultimate goal is conversion to plant nutrients and other materials useful in closure of an ecological life support system for extended planetary missions. The resulting process studied involves hydrolysis at 250 C and 600 psia to break down and compact cellulose material, distillation at 100 C to remove water, coking at 450 C and atmospheric pressure, and catalytic oxidation at 450 to 600 C and atmospheric pressure. Tests were conducted with a model waste to characterize the hydrolysis and coking processes. An oxidizer reactor was sized based on automotive catalytic conversion experience. Products obtained from the hydrolysis and coking steps included a solid residue, gases, water condensate streams, and a volatile coker oil. Based on the data obtained, sufficient component sizing was performed to make a preliminary comparison of the catalytic technique with oxidation for processing waste for a six-man spacecraft. Wet oxidation seems to be the preferred technique from the standpoint of both component simplicity and power consumption. Author

**N88-10492#** Oak Ridge National Lab., Tenn.

## A METHODOLOGY FOR DYNAMIC TASK ALLOCATION IN A MAN-MACHINE SYSTEM

L. E. PARKER and F. G. PIN 1987 20 p Presented at the 2nd International Symposium on Methodologies for Intelligent Systems, Charlotte, N.C., 14 Oct. 1987

(Contract DE-AC05-84OR-21400)

(DE87-007373; CONF-871043-1) Avail: NTIS HC A03/MF A01

A methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation is presented. This paper addresses symbiosis containing two symbiotic partners which work toward controlling a single manipulator arm for the execution of a series of sequential manipulation tasks. The proposed automated task allocator uses knowledge about the constraints/criteria of the problem, the available resources, the tasks to be performed, and the environment to dynamically allocate tasks to the man and the machine. The presentation of the methodology includes discussions concerning the characteristics of the man-machine symbiotic system, the interaction of the knowledge areas, the flow of execution, and the dynamic nature of the task allocation. DOE

**N88-10493** National Physical Lab., Teddington (England). Div. of Information Technology and Computing.

## GENDER AND COGNITIVE STYLE DIFFERENCES AT THE HUMAN-COMPUTER INTERFACE

C. J. H. FOWLER and DIANNE M. MURRAY Jun. 1987 16 p

Presented at the 2nd IFIP International Conference on Human-Computer Interaction INTERACT 87, Stuttgart, West Germany, Sep. 1987

(NPL-DITC-90/87; ETN-87-90932) Avail: Issuing Activity

It is suggested that gender and cognitive style factors may be important in determining the most effective interface style for a particular user or user group, especially in the formative stages of human-computer interaction. Given the substantial evidence of differential treatment of the two sexes at school and at work, there is a need to increase the awareness of designers to the possibility of sex related individual differences at the level of the interface. There is also a great deal of work required in the schools, in order to ensure that both sexes receive equal treatment in computer exposure and usage. ESA

**N88-10494** National Physical Lab., Teddington (England). Div. of Information Technology and Computing.

## SYSTEM ADAPTIVITY AND THE MODELLING OF STEREOTYPES

DAVID BENYON, PETER INNOCENT (Leicester Univ., England), and DIANNE M. MURRAY Jun. 1987 14 p Presented at the 2nd IFIP International Conference on Human-Computer Interaction, INTERACT 87, Stuttgart, West Germany, Sep. 1987

(NPL-DITC-91/87; ETN-87-90933) Avail: Issuing Activity

Automatic adaptation of computer systems to the changing needs of users over time and to individual users or classes of users is discussed. The argument for adaptivity in a system is developed and related to theoretical work on adaptive interface design. Experiments to provide a formalism for system adaptivity are described. The experimental vehicle is a small CBT/tutoring system which incorporates embedded models of individual characteristics and student information in the form of stereotypic attributes and user profiles. Results suggest that the experimental paradigm must be refined, and a larger, more variable subject pool used. ESA

**N88-10988#** Joint Publications Research Service, Arlington, Va. **HUMAN FACTORS IN ROBOTIC SYSTEM DESIGN DISCUSSED**

V. N. PROKOFYEV and T. A. CHERNYSHEVA *In its USSR Report: Engineering and Equipment* p 53-56 4 May 1987 Transl. into ENGLISH from *Izvestiya Vysshikh Uchebnykh Zavedeniy: Mashinostroyeniye* (Moscow, USSR), no. 8, Aug. 1986 p 76-78

Avail: NTIS HC A07/MF A01

A principle underlying the investigation of a manipulation robot with hydraulic drive remotely controlled in a semiautomatic mode is discussed. Experimental data is presented on the operation of the hydraulic drive of the manipulator obtained by the frozen coefficient method. Parameters are obtained at which the system is stable. Results are presented of an investigation of the man operated hydraulic drive system with tracking (accomplishing the operation of gripping a floating object) at a frequency of 0.1 Hz. Author

**N88-11371#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Space Development Div.

## ENVIRONMENTAL LIFE SUPPORT SYSTEM TECHNOLOGY STUDY Final Report

Paris, France ESA Apr. 1987 34 p Prepared in cooperation with Brunel Univ., Uxbridge, United Kingdom, Construcciones Aeronauticas S.A., Madrid, Spain and Kernforschungsanlage, Juelich, Federal Rep. of Germany

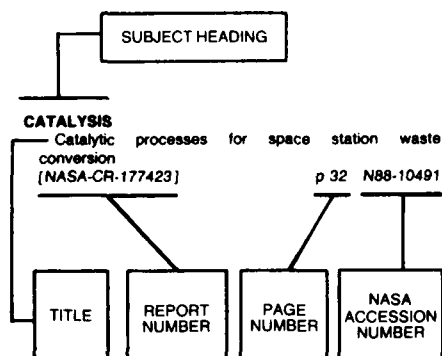
(Contract ESTEC-6052/84-NL-PB(SC))

(ESA-CR(P)-2432; ETN-87-90888) Avail: NTIS HC A03/MF A01

A spaceborne environmental life support system concept where alga (*Chlorella* sp.) is cultivated in a special culture vessel was developed. The oxygen-rich algae medium passes a gas exchanger where the oxygen is exchanged against carbon dioxide to supply the algae with a carbon source. Maltose should be extracted with

a special membrane out of the medium, so that the medium can be recycled without problems. Oxygen and maltose are used to supply a maltose-consuming biological experiment (bacterial culture).  
ESA

## Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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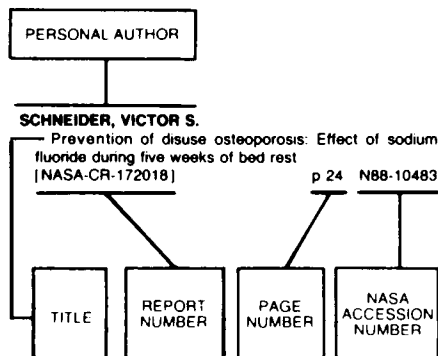
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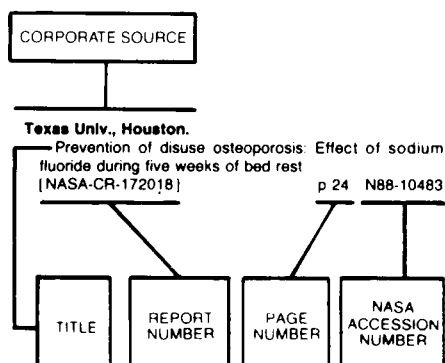
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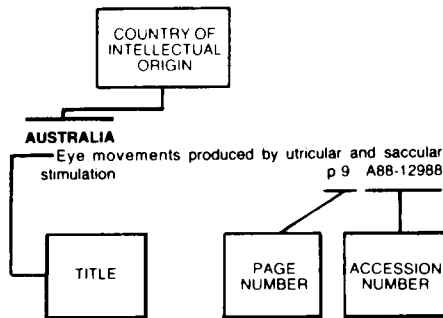
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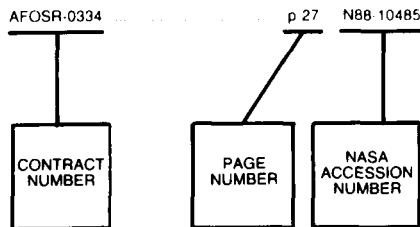
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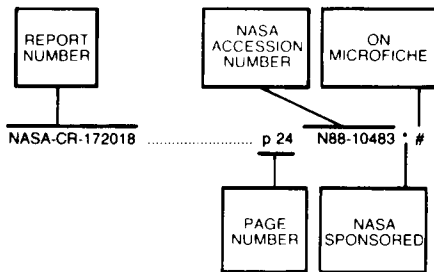
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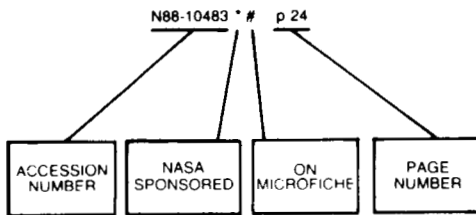
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